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BOTANIC

Kew.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

MISSOURI
BOTANICAL
GARDEN.

1887.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
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1887.


SHOUT
SHARE
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BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 1.] JANUARY. [1887.

NOTICE.

It is proposed to issue from time to time, as an occasional publication, notes too detailed for the Annual Report on economic products and plants, to which the attention of the Staff of the Royal Gardens has been drawn in the course of ordinary correspondence, or which have been made the subject of particular study at Kew. It is hoped that while these notes will serve the purpose of an expeditious mode of communication to the numerous correspondence of Kew in distant parts of the Empire, they may also be of service to members of the general public interested in planting or agricultural business in India and the Colonies.

W. T. Thiselton Dyer,
Director.

1st January 1887.

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1887.

Price Twopence.

I.—TEFF.

(*Eragrostis abyssinica.*)

Inquiry having been made at Kew with respect to an Abyssinian cereal of economic value, suitable for cultivation at high elevations, steps have been taken to collect information on the subject, as well as to obtain a supply of seed for distribution.

The following letters and extracts afford a very complete account of Teff; seed will in due course be forwarded to such Botanic Gardens in India and the Colonies as are suitable for its experimental cultivation.

1.

Extract from Richard, *Tentamen Floræ Abyssinicæ*, 1851, Vol. II., p. 429, under *Eragrostis abyssinica*, Link; Nomina abysinica; Ttheff, Tteff, Thaff.

Teff is one of the cereals indigenous to Abyssinia. It is cultivated in a great number of provinces at a height which varies between six and seven thousand feet above the sea level.

Like all other cereals, Teff presents several varieties, some depending on its relative height, others on its general colour.

Thus there is—

1. Green Teff: or Tchangar;
2. White Teff: Ttsada Tthef;
3. Red Teff: Beneigne Tthef;
4. Purple Teff: Kqhaie Tthef.

These different varieties are all cultivated alike. Teff requires four months from the time it is placed in the earth for its grain to become perfectly ripe. In the neighbourhood of Gondar, Teff is sown in August and reaped at the end of November or beginning of December. In good years, it returns about 40 times the seed, and only 20 times in bad years.

The flour of Teff is very white, and produces a bread of excellent quality.

2.

Extract from Bruce's *Travels to discover the Source of the Nile*, Vol. VII., pp. 184–6.

[*Eragrostis abyssinica.*]

This grain is commonly sown all over Abyssinia, where it seems to thrive equally on every sort of ground; from it is made the bread which is commonly used throughout Abyssinia. The Abyssinians, indeed, have plenty of wheat, and some of it of an excellent quality. They likewise make as fine wheat bread as any in the world, both for colour and for taste; but the use of wheat bread is chiefly confined to people of the first rank. On the other hand, Teff is used by all sorts of people, from the king downwards; and there are kinds of it which are esteemed fully as much as the wheat. The best of these is as white as flour, exceedingly light, and easily digested. There are others of a browner colour, and some nearly black; this last is the food of soldiers

and servants. The cause of this variation of colour is manifold; the Teff that grows on light ground having a moderate degree of moisture, but never dry; the lighter the earth is in which it grows, the better and whiter the Teff will be; the husk, too, is thinner. The Teff, too, that ripens before the heavy rains, is usually whiter and finer; and a great deal depends upon sifting the husk from it, after it is reduced to flour, by bruising or breaking it in a stone mill. This is repeated several times with great care, in the finest kind of bread, which is found in the houses of all people of rank or substance.

* * * * *

The fruit, or seed, is oblong, and is not so large as the head of the smallest pin; yet it is very prolific, and produces these seeds in such quantity as to yield a very abundant crop in the quantity of meal.

3.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR, Royal Gardens, Kew, 23rd June 1886.

I AM directed by Mr. Thiselton Dyer to bring under the notice of Lord Rosebery the desirability of obtaining seed of a valuable cereal commonly sown all over Abyssinia, where it seems to thrive equally on every sort of ground and from which is made the bread ordinarily used in that country.

2. It is called locally Teff, Ttheff, or Thaff, and known to botanists as *Eragrostis abyssinica.*

3. It appears to be an indigenous Abyssinian cereal cultivated at high elevations, from 6,000 feet to 7,000 feet above the level of the sea, of which there are several varieties depending on size and colouration.

4. No specimens of this grain are in the Museums of Economic Botany at Kew, and practically it appears to be unknown outside the confines of Upper Egypt and Abyssinia. An interesting account, under article Teff, is given in Bruce's Travels, Vol. VII., p. 184.

5. These facts have been ascertained in consequence of inquiries made at Kew for seeds of Teff, and it would appear to Mr. Thiselton Dyer that the grain might be very advantageously introduced to certain hill stations in India, to elevated portions of our colonial empire, and, indeed, to all places where maize and wheat cannot be successfully cultivated.

7. Mr. Thiselton Dyer would, under these circumstances, esteem it a favour if you will be good enough to lay this letter before Lord Rosebery, and ask that the Vice-Consul at Berbera be instructed to endeavour to procure a bushel or so of seed of Teff and forward it here by first convenient opportunity.

I have, &c.,
(Signed) D. MORRIS.

Sir Villiers Lister, K.C.M.G.,
Foreign Office.

4.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

Foreign Office, 18th November 1886.

SIR,

WITH reference to your letter of the 23rd of June, I am directed by the Earl of Iddesleigh to transmit to you herewith a copy of a despatch from Her Majesty's Chargé d'Affaires at Cairo, respecting two bags of Tscheff (*Eragrostis abyssinica*) seed which Mr. Portal has procured through the kindness of General Géné, the officer commanding the Italian garrison at Massowah.

The bags of seed have not arrived at this office, and I am to inquire whether they have been received at Kew Gardens direct from Egypt.

I am, &c.,

(Signed) J. PAUNCEFOTE.

The Assistant Director,
Royal Gardens, Kew.

Enclosure in Foreign Office Letter, No. 1.

No. 416.

Cairo, 16th October 1886.

MY LORD,

WITH reference to Lord Rosebery's despatch to Sir E. Baring, No. 138, of the 30th June last, forwarding copy of a letter from the Director of Kew Gardens, asking that, if possible, samples should be procured of a cereal called Teff or Tcheff (*Eragrostis abyssinica*), I have the honour to report to your Lordship that through the kindness of the Italian Acting Consul-General, I have been enabled to forward to your Lordship two bags of the seed required which has been procured for him at his request by General Géné, the officer commanding the Italian garrison at Massowah.

General Géné explains that one of the bags contains white Tcheff and the other red Tcheff, that both sorts are cultivated in the same manner, but that the former is more generally preferred by the well-to-do natives on account of its colour.

I have the honour to enclose copy of M. Venanzi's note to me, and of my reply, in which I have taken the liberty of conveying to him and to General Géné the thanks of your Lordship for the kind and courteous readiness which they have shown to comply with the request contained in Lord Rosebery's despatch above quoted.

The bags containing the seed have been forwarded by sea to the address of the Foreign Office.

I have, &c.,

(Signed) G. H. PORTAL.

The Earl of Iddesleigh, G.C.B.

Enclosure in Foreign Office Letter No. 2.

Alexandrie, 14 Oct. 1886.

M. ET CHER COLLÈGUE,

ME référant à la Note que Sir E. Baring, m'a fait l'honneur de m'adresser en date du 12 Juillet dernier, je m'empresse de vous informer qu' aujourd'hui même j'ai fait expédier par chemin de fer, comme du

connaissement ci-annexé, à l'adresse du Consulat Genl. de S.M.B. au Caire une caisse contenant deux sacs de semence de Tieff (*Eragrotis abyssinica*).

Le Général Gene, que j'avais prié de me procurer à Massowah les semences susdites et qui bien volontiers se chargea de cette commission m'écrit que l'un des sacs contient du Tieff *blanc* et l'autre du Tieff *rouge*, la cultivation des deux semences est la même, mais la première est préférée à cause de sa couleur par les indigènes moins pauvres. Bien heureux d'avoir pu satisfaire au désir exprimé par votre gouvernement.

Je suis, &c.
(Signé) G. Venanzi.

5.

Foreign Office to Royal Gardens, Kew.

Sir, Foreign Office, 2nd December 1886.

With reference to my letter of the 26th ultimo, and to previous correspondence relative to the Tchef seed which has been procured for Kew Gardens through the kindness of the Italian officer commanding at Massowah, I am directed by the Earl of Iddesleigh to forward to you the accompanying paper which has been sent to Sir E. Baring by M. de Martino, the Italian Agent and Consul-General at Cairo, giving various details as to the nature, qualities, mode of cultivation, &c. of the cereal in question.

I am, &c.
(Signed) J. Pauncefote.

The Assistant-Director,
Royal Gardens, Kew.

Enclosure.

Olkraur, 27th September 1886.

Cultivation of Thaf or Thief.

Thaf (in the Tigrina language) or Thief (in the Olmharigna language) belongs to the family of grasses and resembles the finest lawn grass.

There are two kinds: white Thaf and red Thaf. Both are, moreover, of two different qualities, according to the time of sowing, and are in consequence distinguished by the names of the seasons; "Thaf-*Hagaiz*" and "Thaf-*Tseddia*." The first is called "hagaiz," from the name of the season which, according to Abyssinian reckoning, includes all our winter and the commencement of our spring; it is sown at the end of Megabit, in Myazya and Ghembot (March, April, and May). The second is called "Tseddia," from the name of the commencement of the rainy season, which follows that of Hagaiz and precedes that of Keremt; it is sown in June and at the commencement of July.

Thaf-Hagaiz is of slow, and Thaf-Tseddia of rapid growth. These conditions produce great difference in quality, Thaf-Hagaiz being considerably superior; the *white*, especially, is used for the table by the Court and Chiefs. Thaf-Tseddia is of very inferior quality, and the flabby cake, or the "Tabita," which is produced from its flour, is as disagreeable to chew as if it were mixed with sand.

It is therefore the early sowing and vigorous growth of Thaf-Hagaiz, due to being two months longer in the ground, that render it of superior quality.

I ought, however, to add that "Hagaiz" and "Tseddia" cannot be sown indifferently for one another. The experiments which the natives tell me have been made have not met with much success. The seed of Thaf-Hagaiz must be used for the first sowing, and that of Tseddia for the second. The difference between them, both in the case of the white or red, is quite perceptible to the naked eye, by the want of plumpness characteristic of the Thaf-Tseddia relatively to the other.

These seeds almost equal barley in their growth and the rapidity with which they come up. Sown at the end of March or in April and May, they arrive at maturity at the beginning of September. Sown in June or July the crop may be reaped in October.

They are cultivated in the warm regions of the "Konalla," or low-lands, at an altitude of from 1,300 to 1,800 metres, and especially in the temperate regions of the "Ouaynè-Dega," at an altitude of from about 1,800 to 2,400 m.

The Thaf comes up very vigorously in heavy lands, but its large and high tuft is richer in herbage than in grain. The exuberance of its vegetation in these heavy lands causes it to be laid, and then its ear rots. It prefers light soils and adapts itself even to the most sandy; it then produces slender, wiry stems, and supports better the weight of its ear.

The land requires to be prepared and cleaned by three or four ploughings before sowing; but it is true that the ploughings in Abyssinia are light and not very deep. It is sown thickly on the surface of prepared ground. It is afterwards lightly hoed, if necessary, when it has come up.

It is not necessary to wait until it is quite dry, like barley, to cut it, for when too ripe and dried, the grain sheds in the wind and at the least shock. It is cut as soon as the green ear turns to grey, in the early morning, and is placed in heaps with the ears inwards, and covered to preserve it from the rain; it is then left to ripen and to undergo a certain amount of fermentation.

Its flour is only advantageously used in making "Tabita," a kind of large fermented pancake. The "Tabita" of Thaf is most easily digestible, and has none of the bitterness of some other kinds of grain.

(Signed) E. Coulbeaux,
Missionnaire apostolique en Abyssinie.

6.

Analysis of "Teff," red variety, by Professor A. H. Church, M.A., F.C.S.

	In 100 parts.
Water - - - -	15·2
Albuminoids - - -	8·2
Starch, &c. - - -	68·1
Oil - - - -	2·8
Cellulose, &c. - - -	2·8
Ash - - - -	2·9

The ratio between the albuminoids, or flesh-formers, and the heat-givers, or force-producers (calculated as starch), is here 1·9. This ratio is less satisfactory than that of the majority of the millets, but is near that of *Panicum Miliare*.

II.—OIL OF BEN.

Considerable interest attaches to the origin of Oil of Ben, which is supposed to have been exclusively used many years ago by watch and clock makers. It was said to possess special properties, amongst others, that it would not thicken with age, that it remained liquid under very low temperatures, and, lastly, did not become rancid.

Whether such an oil was a natural product or the result of a special treatment of olive and other oils is not clearly known.

For many years an effort has been made by the Hon. H. J. Kemble, of Jamaica, to prepare Oil of Ben from the seeds of *Moringa pterygosperma*, which is well known as the horse-radish tree of tropical countries, and plentifully distributed in both the East and West Indies. The seeds of this tree yield 30 per cent. by weight of a clear, limpid, almost colourless oil. It has a specific gravity of 0·912 at 60° F., it is fluid at 77° F., and solid below 60° F. After separation of the solidifiable portion it forms a clear oil, of which a fine specimen from Madras, more than thirty years old, is now in the Kew Museum.

If this oil were proved to be identical with Oil of Ben there is no doubt its production would be immediately undertaken on a large scale. Dr. Watt states that *Moringa pterygosperma* is so extensively cultivated in India that that country alone could easily enough, and with profit, supply the whole world with Oil of Ben. Similar conditions exist in the West Indies, where the oil can be produced, by cold pressing, at about 8*s*. to 10*s*. per gallon.

In the Report of the Director of the Botanical Department, Jamaica, for the year 1883, it is stated that,—"Great interest is still being taken "in the extraction of Oil of Ben from the seed of the common horse-"radish tree (*Moringa pterygosperma*). Last year I took with me "to England a fine sample of oil prepared by pressure by Mr. Kennedy. "The report which I received from Messrs. Silver and Co. was as "follows:—'It is an oil altogether unknown in this market, the sample "'is far from being bright, and in its present state would be useless "'for either of the trades named in your memorandum.

"'Whatever the oil may be in the West Indies, it appears to be very "'tender here, and although only about three parts congealed now, "'would in the winter months be entirely so.'

"If *Moringa pterygosperma* yields the true Oil of Ben, the prepara-"tion evidently must be different to that hitherto pursued; and it is "possible that the tender condition of the sample submitted to Messrs. "S. W. Silver and Co. was owing to the presence in it of a large "proportion of stearine which should be removed."

The properties and value of the oil of *Moringa pterygosperma* having been so far determined, the next question was to discover whether any other species of Moringa yielded the true Oil of Ben. The genus Moringa consists of only three species, and these are *M. pterygosperma*, Gaertn, *M. aptera*, Gaertn, and *M. concanensis*, Nimm.

The latter is probably only a form of *M. pterygosperma* with larger leaflets; and it can very well be passed over in the present inquiry. There only remains, therefore, *Moringa aptera*.

This latter species has a comparatively narrow distribution, and appears to be confined to Upper Egypt, some parts of Syria, and Aden. At the latter place it was collected by Sir Joseph Hooker in 1847, and he describes it as a "weeping tree, about 17 feet high, yielding a red

" brown gum." Other travellers have collected specimens at Aden, now in the Kew Herbarium, among whom may be mentioned Anderson, 1859, and Bayley Balfour, 1880.

In Irby and Mangles' Travels in Petræa and the Dead Sea, p. 469, there is the following reference to this tree :—" A very singular plant " grows near the hot sources [Callirrhoe springs], of the bulk and " stature of a tree; its foliage does not seem to differ from that of the " common broom. It bears a pod hanging down from it about a foot " or fourteen inches in length fluted with convex ribs from the end to " the point; we never met this before."

Specimens in the Kew Museum marked " Seed of a tree near the hot " springs of Callirrhoe," evidently refer to the above, and are undoubtedly *Moringa aptera*.

The Kew Herbarium possesses specimens collected by Lord in the Sinai Peninsula in 1868, by Lowne at Engedi in 1864, by Ehrenberg in Arabia in 1870, by Rohr in Abyssinia in 1841, and by Schweinfurth, Thebais in 1885.

The following note appears on a specimen from Gay's Herbarium :— " Delile m'a dit, le 17 Octobre 1835, qu'il falloit rapporter au *Moringa* " *aptera*, le *Moringa nux Ben* de sa Fl. Ægypt. Illustr., p. 81. Les " graines qui se vendent dans les boutiques du Caire et d'Alexandrie, " sous le nom de habbat et ghâlz, et dont on extrait l'huile de Ben, " appartient au *Moringa aptera*, Gaertn."

According to Decaisne [Ann. des Sc. Nat. 2e ser., Vol. IV., pp. 204, 205], *Moringa aptera* has been introduced at Cairo, where it is now cultivated from seeds brought from Sennaar. Thence they are exported into Syria.

" Il parait certain que ce sont elles qui produisent, par l'expression de leurs cotyledons, l'huile de Ben du commerce, c'est du moins l'opinion des anciens auteurs. Van Rheede et Rumphius, qui s'entendent longuement sur une foule d'usages auquels on emploie les feuilles ou les graines du *Moringa pterygosperma* ne disent cependant pas qu'on en fasse de l'huile, tandis que Belon fait plusieurs fois mention de ce produit et de l'arbre lui-même, sous le nom de *Balanus myrepsica*. Il le cite dans son voyage au Mont Sinai, où il ne parait plus exister aujourd'hui."

In the hope of obtaining seeds, application was made to Dr. Georg Schweinfurth, the celebrated African traveller; the following reply was received :—

Dr. Schweinfurth to Director, Royal Gardens, Kew.

Dear Sir, Cairo, 11th October 1880.

I found your kind letter of the 19th September on my return from the Lebanon, where I spent the last summer, and I hastened to get the information you wanted about the Ben-oil.

I visited many of the old Arabian oil presses here, but nobody knew anything of Moringa or of its products, although I showed specimens of the fruits. It appears to me probable that Moringa oil is not now manufactured in Cairo, but that it is imported from elsewhere, if at all in use.*

Moringa aptera, Gaertn (Moringa arabica, *Lam.*, Hyperanthera peregrina, *Forsk*, H. semidecandra, *Vahl.*), grows wild in the East-Arabian desert of Upper Egypt, and I found it often in the mountains

* No mention is made of Moringa oil in Figari's " Studj scientifici sul Egitto," in which work all drugs of Cairo are enumerated.

south of Kossér, near the Red Sea; on the Gebel Abu Tiũr, in Wady Hendōsse, the northern limit was in Wadi Hauaschieh, northward of Gebel Gharib. The tree occurs also frequently on the borders of the Nubian desert; I found it there on the Gebel Soturba (22° North lat.), on the Gebel Waraṭáb, near Suakin, on the Gebel Iskenáb, at the road Suakin-Kassala. I have specimens of it in my herbarium from the land of the Habab (between Suakin and Massawa), also from Aden and Gumfuda (also in Dongola).

In the gardens of Cairo is *Moringa aptera* nowhere to be found, whilst *M. pterygosperma* is largely distributed. I have about 5 lbs. of seeds of the latter, which are at your disposition, if you need any. These seeds develop well here, and contain much oil.

I am sorry not to be able to send you the desired seeds of *M. aptera*.

I am, &c.

(Signed) G. Schweinfurth.

P.S.—The Arabian name among the Bedouins in Egypt is "El Yes-"sár" for *M. aptera*, while "El Ben" is the Arabian (or Persian) name for *M. pterygosperma*.

In 1885 seed of *Moringa aptera* was received from Messrs. Haage and Schmidt, of Erfurt, and a small quantity was distributed to Jamaica, Demerara, Dominica, Calcutta, and Ceylon. In May of the present year a few seeds were obtained from Mr. Ernest A. Floyer, Inspector General of Egyptian Telegraphs, who mentions that the Arabic name of the tree is "Yessar," and describes the tree as growing to a height of 20 feet. He further mentions that in the valley of Kittar, a mountain gorge with a single pool of water, surrounded by 96 miles of treeless and waterless desert, "The tree has leaves in long spines like a tamarisk, "and has copious sprays of waxy flowers, with a beautiful smell like "fresh hay, and an additional merit, very good camel fodder."

A few seeds additional to the above were received from Dr. Schweinfurth in June of this year, which, with seeds previously received, were sown at Kew, and yielded several strong plants.

It is a noticeable point with regard to young plants of *Moringa aptera* that they form a tuberous root, during the first year's growth, of considerable size. This tuber, it appears, is eaten by the Bedouins, and in taste is very similar to the common radish.

As regards the oil yielded by the seeds of *Moringa aptera*, nothing as yet can be done. When the plants now growing in the East and West Indies have produced seed they will be tested with this view, and the subject again brought under notice.

D. M.

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ROYAL GARDENS, KEW.

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MISCELLANEOUS INFORMATION.

No. 2.] FEBRUARY. [1887.

III.—CAPE BOXWOOD.

(*Buxus Macowani.*)

The record of the discovery of a new species of *Buxus* in South Africa is a matter of some interest, not alone from a botanical point of view in consequence of its being the first representative of the genus discovered in South Africa, but economically, because it is thought that the wood may yet become an article of commerce in this country as a substitute for true Boxwood for wood engraving.

The history of the introduction of this wood to the notice of the London hardwood merchants has been given in the "Journal of the Society of Arts" for March 19th, 1886, p. 465. In April 1885 I received a letter from Mr. W. M. E. Welby, of East London, Cape Colony, asking me to give him what information I could on the subject of Boxwood or its substitutes for wood engraving, and further stating "I have a considerable quantity of Cape Boxwood and other hard woods "growing on my farm that I am anxious to turn to some account, and "if the wood in question is really valuable, possibly you could oblige "me with the name of some respectable firm with whom I could "communicate with a view to sending home samples."

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1887.

Price Twopence.

In replying to this letter I gave Mr. Welby the name of Mr. Godfrey S. Saunders, then of 106, Fenchurch Street, a gentleman who has had an extensive experience in hard woods, and to whom the Kew Museum is indebted for frequent reports upon various woods that have been received from time to time. I also asked that a good sample of the wood might be sent for the Museum, thinking it might perhaps prove a better specimen than that of the Cape Box (*Celastrus buxifolius* L.) already contained in the Museum, with which I assumed the wood referred to by Mr. Welby was identical. In July I received another letter from Mr. Welby, of which the following is an extract, "Acting "upon your advice I have addressed a box of wood samples to Mr. "Godfrey S. Saunders, Fenchurch Street, and have enclosed therein a "piece of Boxwood for you which I have asked him to be kind enough "to hand over to you. Immediately on receipt of your letter, I wrote "to the Conservator of Forests for the scientific name of the Boxwood, "but have not yet received his reply. I may state, however, that the "name mentioned in a newspaper article is *Celastrus buxifolius*. Should "this not prove correct, I will write and inform you. Unfortunately "I forgot to put some leaves in the box, and therefore enclose a few "herein. I have never seen the tree in blossom, nor do the natives "seem to know what the flower is like. If, however, it does bear a "flower, I will send you a sample at some future date. The tree grows "to an average height of 30 feet, and as a rule does not exceed 12 or 14 "inches in diameter."

Upon examining this wood, and comparing it and the small specimens of foliage sent with those of *Celastrus buxifolius*, I found that they did not agree, but that the foliage very nearly resembled that of true Box (*Buxus sempervirens*), and upon comparing this sample of Cape Boxwood with Black Sea Boxwood, I found the two woods to be almost identical, so that it was clear the Cape Boxwood was none other than a species of *Buxus*, and perhaps *B. sempervirens* itself.

In September 1885, Mr. Godfrey S. Saunders wrote to me as follows:—Almost simultaneously with the arrival of Mr. Welby's samples, two other samples of the same sort of wood reached here to some friends of mine, so I have had the opportunity of testing not only Mr. W's, which had been seasoning for two years, but also the fresh wood. I have had pieces distributed amongst six practical men, and though they all report favourably of its appearance, they all unite in saying that it does not cut smoothly, but "harsh," "ragged," and that the cutter "blurrs" on the wood, whereas genuine Box cuts quite smoothly. There is also a nasty tendency to split from the centre outwards, instead of the clean way in which Boxwood splits, so that the end of every piece has a series of star shakes. In addition, every log I have cut has very many black specks, quite spoiling it for first rate work, even if good in other respects.

The *Indian Forester* for November 1885 drew attention to the arrival at the West India Dock of 55 pieces of Cape Boxwood, weighing nearly three tons, and described the logs as being of good sizes, and sound and clean grown, and possessing a closeness of grain almost equal to the best Abassian Boxwood, so that it was thought it would be suitable for engraving purposes.

In the report of the Conservator of Forests, King William's Town, for the year 1884, p. 23, it is stated "The coast forests have come into "notice during the year by the discovery that the so-called Cape Box-"wood is of value for engraving and other purposes, for which real "Boxwood is used. The area of Box producing forest in the Buffalo

" River Valley is estimated at 15 square miles. Box also occurs in the " valley of the Keiskama River, near the coast, but has not as yet been " detected west of this in the valleys of the Fish River, Kowie River, " and Bushman's River. A few real Box trees (*Buxus sempervirens*) " have been planted out in the forests in the King William's Town, " Stutterheim, and East London divisions, and supplies of Box seeds for " stocking the nurseries are expected from Paris and India. That from " India, the produce of the Himalayan Box, will probably prove of the " greater value."

Under the head of *East London Forests*, at p. 51 of the same Report, the following occurs :—" The event of the year for these forests has been " the discovery of the commercial value of Cape Boxwood. This is a " small tree like the generality of trees in the East London forests. It " is rarely met with over a foot in diameter by 25 of bole, but it is suf- " ficiently abundant to furnish a large supply of wood. Submitted to " an expert it has been declared to be worth about one penny a cubic " inch, if seasoned, free from cracks.

" Cape Box, Kafir (Gara-gara) does not appear to coppice, but has a " good natural production from seed. The tree was placed on the " reserved list a year ago ; previous to that it had been sold at 5*s*. the " waggon load for firewood. A linear survey, undertaken mainly with " the object of getting an estimate of the quantity of Boxwood in the " East London forests, is now being executed by Captain Ricketts, the " local Ranger."

At the end of 1885 Professor Macowan, Director of the Botanic Gardens, Cape Town, forwarded to Kew specimens which enabled Professor Oliver to describe and figure the South African Box as new species of *Buxus*, under the name of *Buxus Macowani* [Icones Plantarum, t. 1518].

Amongst the woods shown in the Cape Court the recent Colonial and Indian Exhibition were some small samples of this Boxwood, the general appearance of which was not such as to recommend it to the notice of wood engravers, notwithstanding that the Cape catalogue referring to this wood says :—" When Cape Boxwood is better known " in the English market, it is anticipated that an export trade will be " established. Small shipments have already been made to introduce the " wood which is very favourably reported on for engraving purposes," and it is further stated that *The Timber Trades Journal* of 22nd August 1885 declares this wood to be one of the best yet put forward as a substitute for the ever decreasing supply of true Box. The success here anticipated has scarcely yet been borne out by experience. But there is little doubt that a wood suitable for engraving purposes is greatly in demand. If the present Cape Boxwood does not fully meet the requirements of engravers, the subject is one which deserves attention at the Cape and elsewhere. It is but natural to suppose that among so many Colonial timbers there may be one which, if not identical with Boxwood, may possess so many desirable qualities as to commend it for general use.

J. R. J.

IV.—INDUSTRIES AT MAURITIUS.

The following correspondence has passed between the Colonial Office and Kew in regard to industries at Mauritius.

As some of the industries treated here are the subject of inquiry from other Colonies, the correspondence will prove of interest, not only to Mauritius, but to other portions of Her Majesty's possessions :—

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, 17th August 1885.

With reference to your letter of the 2nd of May, I am directed by Secretary Colonel Stanley to transmit to you, for such observations thereon as Sir Joseph Hooker may have to offer, the accompanying copy of a despatch from the Governor of Mauritius, enclosing the preliminary report of a Committee which had been appointed to inquire into and report upon the best means of encouraging the cultivation of other products besides sugar.

Colonel Stanley will feel obliged for any suggestions which Sir Joseph Hooker's experience may enable him to make as to the industries which would be most likely to meet with success in Mauritius, and the special steps to be taken to ensure, as far as possible, such success.

I am, &c.

W. T. Thiselton Dyer, Esq., C.M.G., (Signed) John Bramston.
Royal Gardens, Kew.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, 18th August 1885.

I have the honour to acknowledge the receipt of your letter of August 17th, transmitting, for the information of Sir Joseph Hooker, a copy of a despatch from the Governor of Mauritius, with enclosures relating to the promotion of new planting industries, in the Colony. I am to make the following remarks on a perusal of these papers :—

2. Tobacco is only an exhausting crop, in the sense that its quality rapidly deteriorates on soil which is not kept to a high standard of fertility. In Cuba the alluvium brought down by rivers perpetually renews the soil on which the tobacco is grown. But tobacco nevertheless of average quality is grown to an enormous extent in various parts of the world. If it can be grown "of a quality sufficiently good to command remunerative prices in Réunion" it would certainly seem to deserve encouragement in Mauritius.

3. With regard to tea, Sir Joseph Hooker thinks that due caution must be exercised. Mauritius will have to meet the competition of Ceylon and India, in which the cultivation is capable of almost indefinite expansion. Tea, moreover, to be a profitable industry, is entirely dependent on an exact adjustment of the supply of labour. It must also be remembered that the extension of tea cultivation in Mauritius means the ultimate destruction of the little remaining high-level forest.

4. More attention ought undoubtedly to be paid to Cinchona. Reference may be made to the report of Her Majesty's Consul at Réunion, dated August 25th, 1881, which shows that in that island, at any rate, the

cultivation of Cinchona apparently presents no physical difficulties. I may also refer to my letter of March 7th, 1881, to Sir Robert Herbert, which was referred to the Government of Mauritius, but elicited no further reply. The economy in the large expenditure by the Government of Mauritius upon quinine, presumably imported from Europe, would alone seem to justify some intelligent activity in the matter.

5. The leaf disease of the coffee in Ceylon has unfortunately extended to Mauritius. Liberian coffee, though not apparently enjoying complete immunity from the disease, is less susceptible to it than the ordinary kind. Its cultivation may also be carried on at a lower level. There is believed to be a steady demand for this kind of coffee in the United States.

6. As to silk, if it is intended to grow any of the mulberry-feeding kinds, Sir Joseph Hooker cannot but apprehend that the climate of Mauritius will be found too hot, and the Indian Tasar silks have not yet been domesticated.

7. With regard to wheat, &c., it is hardly conceivable that in the face of the great areas devoted to this staple in India and Australia that Mauritius can do much more than for local consumption. The cultivation of oil-seeds is a more promising industry, and for these there would be probably a good market at Marseilles.

8. Something might be done probably with Cacao, in carefully selected situations. The cultivation of Vanilla was taken up in Réunion in 1850 after the failure of the sugar cane. It is now said to be the mainstay of that island. The preparation of the pods is peculiarly an industry suited to the resources of small proprietors.

9. Sir Joseph Hooker would also particularly urge on the attention of proprietors with suitable land the cultivation on their estates of choice woods, such as Ebony and Sandal. For these there is always a demand and a market. The cultivation of spices, such as Cloves, is also worth attention.

10. It is to be regretted that the apparently promising fibre industry has not prospered. That there must be a solid bottom to it Sir Joseph Hooker is, however, convinced. The aloe fibre produced in the colony met with great favour. Manilla Hemp, again, is a staple unsurpassed in its kind. Finally China Grass, though presenting extreme difficulty in its preparation otherwise than by hand, is a fibre which, if this difficulty could be overcome, would carry everything before it. It is exciting a great deal of attention in Europe at the moment, and, whether by mechanical or chemical means, there is reason to hope that a practicable method will be found of preparing it on a large scale. Sir Joseph Hooker thinks, that on the whole, the best thing the colony can do is to send to Europe some thoroughly intelligent representative, with his heart really engaged in the matter, to study the whole question of the commerce and economic manipulation of tropical fibres. Both in France and England great interest is now taken in the future of China Grass, and such a commissioner should make it his business to thoroughly penetrate the subject.

11. Sir Joseph Hooker would like, as remarked in my letter of May 2 last, to see a report from the Director of the Botanic Garden as to the suggestions that occur to him in the present crisis.

I am, &c.

(Signed) W. T. Thiselton Dyer.

John Bramston, Esq., D.C.L., C.B.,
Colonial Office.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, 2nd December 1886.

Referring to my letter of August 18th, 1885, in which I suggested that the Director of the Botanic Garden, Mauritius, might furnish a report on the economic plants to which, in the present economic position of the colony, attention might be given, I have now the honour to inform you that I have been favoured by Mr. Horne with copies of the enclosed paper.

2. This document reflects great credit on Mr. Horne's knowledge and resource, and, if properly brought under the attention of the residents in the island, can hardly fail to suggest many practicable developments of new cultural industries.

3. Mr. Morris, the Assistant Director of this establishment, having a wide acquaintance with the subject, has drawn up the enclosed memorandum, which I have the honour to submit to the Secretary of State, in the hope that the suggestions it contains may be of some service to the Government of the colony.

I am, &c.

Edward Wingfield, Esq., Colonial Office. (Signed) W. T. Thiselton Dyer.

Memorandum of Observations on Mr. Horne's Report on the Agricultural Resources of Mauritius.

The "Report on the Agricultural Resources of Mauritius," prepared by Mr. Horne, gives in general outline a graphic statement of the present position of local industries outside and beyond that of sugar, which, it may be observed, is the staple industry of the island.

2. The intention and idea of the report evidently has been not so much to suggest industries to take the place of sugar, as to enlarge the scope and area of the smaller industries on lands worn out or not suited to the production of sugar.

3. That Mr. Horne is solicitous as regards sugar as well as other things is apparent in several pages of the report, and no doubt, in common with all who feel an interest in the island, he is anxious to improve the cultivation of the sugar cane, and to see produced at a minimum cost the finest grades of sugar which improved machinery and the best scientific methods can produce.

4. In view of the expenditure already incurred by planters, local societies, and by Government, in introducing new varieties of sugar canes, in fostering Coolie immigration, and in other ways admitting the pre-eminence of sugar, it is evident that the staple industry of Mauritius has received every consideration to which it could fairly lay claim.

5. After stating this much by way of introduction we now come to the suggestions made by Mr. Horne respecting the promotion of such fresh industries, or the revival of old ones, which offer some hope of being profitably taken up alongside of sugar cultivation.

6. The cocoa-nut, which comes first on the list, would appear not to receive that attention at Mauritius which its value and merit deserves, and the suggestion made by Mr. Horne to secure the planting of cocoa-

nuts on the *Pas Geometriques* deserves the attention of Government. Unless there are some grounds for assuming that cocoa-nuts do not thrive so well at Mauritius as in other tropical places in the Indian Ocean, it is somewhat anomalous that this fertile island cannot grow even enough green cocoa-nuts for the use of the inhabitants. It would appear that, in the year 1884, nearly Rs. 30,000 were spent on green nuts imported from other countries, while the total value of the produce of the cocoa-nut palm imported from abroad and consumed in the colony, amounted to Rs. 170,000.

7. The occurrence of periodical hurricanes at Mauritius is a factor which must operate very prejudicially against the establishment of trees as a permanent cultivation. It would appear, however, from Mr. Horne's remarks, that he does not apprehend any "serious loss arising "to cocoa-nut plantations from these hurricanes." If this, as it is presumed to be, is the result of experience and observation extending over many years, there is no reason why this industry, at least, is not greatly extended in all suitable localities.

8. With regard to the cultivation of cacao (chocolate), coffee, cinchona, and tea the case is quite different. These are not likely to thrive except in well-sheltered situations, to escape hurricanes, and, in localities sufficiently cool and moist, to be beyond the influence of prolonged droughts. Cacao is the least likely to thrive in Mauritius. Coffee might thrive if relieved of the attacks of the Ceylon coffee-leaf disease, but of this, however, there would appear to be little hope at present. For local consumption Liberian coffee might be grown, but the tree yielding this, although better able to withstand the disease, being larger than the ordinary coffee, is all the more liable to be damaged by hurricanes.

9. The cultivation of the several species of cinchona, except perhaps to a limited extent red bark (*Cinchona succirubra*), is not likely to be a success at Mauritius, for the extent of land at a suitable elevation even for that species and sufficiently protected from destructive winds must be too small to afford scope for anything more than a limited industry. The cuprea bark trees (Remijia) will grow at a lower elevation than the true cinchona trees, and experiments with these from seed lately sent from Kew would afford more hope of success.

10. Tea is grown in Ceylon from sea level up to an elevation of 6,000 feet, but "the average altitude of the larger districts is about 4,000 feet above sea level." It is possible that all the physical conditions exist for establishirg a tea industry in Mauritius, but it must be borne in mind that unless tea can be grown, manufactured, and placed in the London market at a cost without duty not exceeding 6*d.* to 7*d.* per pound, there will be little hope of successfully competing with the large consignments (estimated at about 40 million pounds) which Ceylon will be able to ship "in the near future." The tea plant in itself is very hardy and grows everywhere. The chief problems, however, are connected with maintaining the plant in a constant state of growth (that is, securing for it a warm, humid, and forcing climate) to ensure large "flushes"; and to have at hand an abundant supply of cheap labour. The large number of tea plants, estimated at about 30,000, already in the island should afford a ready means of testing the capabilities of a tea industry as well as the cost of production.

11. As regards the cultivation of cereals and pulse such plants as maize, rice, millets, and gram, haricot beans, dhal, lentils, peas, all deserve to be grown on a large scale, not only to supply local demands, but also, when favourable markets offer, for export purposes. The consumption of rice

in the colony is very large, and all of it is imported. If there is an appreciable amount of land suitable for the cultivation of rice in the island, the free Coolies might be encouraged to start the cultivation by having leased to them small plots of Government land at nominal rates. An experiment of this kind tried on an estate in Jamaica, proved very successful. To establish a cultivation new to the habits of the people, and to thoroughly popularise it amongst small settlers, it is necessary to offer some substantial inducements at first, and according to the views of the Mauritius Government it might assume the shape of a grant of land or lease for a certain number of years, or a bonus on results, both of which might afterwards be gradually withdrawn.

12. Maize or Indian corn, if suitable to the country, should require only to be brought prominently before the people to be grown to any extent required to meet at least local circumstances. For dry districts there is no cereal which is so well adapted to yield regular crops as Guinea corn and other more or less known species of Sorghum. They afford a large supply of green food for cattle and horses, they bear cutting, and the grain is capable of being utilised in a variety of ways both for man and animals.

13. The Indian immigrants no doubt might be induced to establish the cultivation of gram (*Cicer arietinum*) in Mauritius, which it is noticed is imported to the value of Rs. 673,280. Again dhal (*Cajanus indicus*) is imported to the value of Rs. 349,546 annually. It is a matter for consideration, and to be decided solely by local circumstances, whether these two plants can be grown so cheaply and advantageously at Mauritius as in Southern India; but in view of the enormous sums now paid for imported gram and dhal the subject is one of considerable importance.

14. A careful inquiry into the disease said to affect the crops of dhal (known locally as *Ambrevate* or *Ambrevade*) is obviously necessary; and any practical means that may be suggested should be taken to deal with it. It is possible that the introduction of fresh seed may be advantageous as a first step towards resuscitating an industry which formerly appears to have assumed considerable importance in Mauritius.

15. The capabilities of Mauritius, to grow at least two commercial fruits, viz., bananas and pine-apples, are undoubted. The returns on the exports of these two fruits at Jamaica and the Bahamas amount in the aggregate to nearly a quarter of a million sterling. Hence it is not a question of producing a large variety of fruit so much as of producing cheaply and in large quantities a few commercial fruits for which there is a general demand.

16. It appears from Mr. Horne's report that regular and rapid communication exists between Mauritius and the Cape of Good Hope, and again by the Messageries Maritimes between Mauritius and Adelaide. These circumstances obviously suggest the proper outlet for fresh tropical fruits, especially during the winter months; and either with or without a subsidy to ensure special attention to the fruit during the voyage, the planters and merchants of Mauritius need only be made aware of what is done in this direction in other colonies to avail themselves of such favourable means to develop local industries.

17. Pine-apples will keep without special storage for a voyage of seven to ten days if packed singly in compartments, and allowed plenty of ventilation in a cool hold. For a voyage of 10 to 18 days they require to be kept in a special cool chamber, the temperature of which should be regularly maintained at about 45° Fahrenheit. Under such conditions not only pine-apples, but also bananas, avocado pears, bread-

fruit, melons, papaw, sapodilla, are now received in England from the West Indies, the steamer taking generally 18 days for the whole voyage.

18. Such fruits as cannot be exported in a fresh state might be canned or dried, and under this head the example of Singapore in canning and exporting pine-apples, whole in syrup, might be appropriately brought to notice.

19. Purposely here attention is drawn only to a few special fruits, but it is plainly evident that at Mauritius the subject of fruit growing for export purposes (either in a fresh or canned state) has not been seriously entertained nor has the subject received the attention it deserves.

20. Allied to fruit growing is the subject of growing market-garden produce, for which no doubt there would be considerable demand in a fresh state at the Cape or at the diamond fields, if preserved and put up in a convenient and portable manner.

21. Mr. Horne has very rightly discussed at some length, and given much valuable information respecting starches, dyes, oils, spices, fibres, silk, india-rubber, gutta-percha, tobacco, tanning materials, timbers and fancy woods, all of which deserve attention, and many are undoubtedly capable of being successfully produced in the colony.

22. It is not proposed to discuss these here in detail. As circumstances arise they should be kept in view, and, as a first step to give effect to the suggestions offered, it might be desirable to obtain the latest and most reliable information respecting them and where necessary introduce the plants required for certain new industries.

23. As regards all these industries, whether old or new, it is desirable that detailed cultural and other information of a popular character be prepared for general distribution in the island. Such notes and information printed in the form of leaflets might also contain exact information as regards the most approved methods for preparing and curing the produce, and, indeed, all particulars that may be necessary to familiarise the people with the prosecution of industries comparatively new to them.

24. Mr. Horne's report has dealt with the agricultural resources and economic circumstances of Mauritius in a manner never done before; and if followed up by a practical and judicious effort on the part of the Government and the people themselves, it cannot fail to produce results of a beneficial and permanent character.

D. M.

Colonial Office to Royal Gardens, Kew.

Colonial Office, Downing Street,
13 December, 1886.

Sir,

In reply to your letter of the 2nd instant, I am directed by Mr. Secretary Stanhope to convey his thanks for the observations by Mr. Morris on Mr. Horne's report on the agricultural resources of Mauritius.

Your letter, and Mr. Morris's Memorandum, will be communicated to the Governor for his consideration in connexion with Mr. Horne's report.

I am, &c.
(Signed) Edward Wingfield.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S.,
&c. &c. &c.

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BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 3.] MARCH. [1887.

FIBRE PLANTS.

It is proposed in the following notes to deal briefly with fibres derived from tropical endogenous or monocotyledonous plants which yield what are known in commerce as Sisal Hemp, Manila Hemp, Bowstring Hemp, and Mauritius Hemp. These are used chiefly for rope making and cordage, and are to be distinguished from flax, cotton, and other fibres used purely for textile purposes.

The large and increasing interest taken in fibre plants and the numerous references made to this establishment on the subject render it very desirable to place within reach of cultivators in India and the Colonies a summary of information on the subject.

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1887.

Price Twopence.

The Hemps above enumerated are derived as follows :—

i. Sisal Hemp,

Agave rigida, MILL.

(A. Ixtli, *Karw.*
A. elongata, *Jacobi.*
A. Sisalana, *Perrine.*)

ii. Mauritius Hemp,

Furcræa gigantea, VENT.

iii. Manila Hemp,

Musa textilis, NEES.*

iv. Bowstring Hemp,

Sansevieria zeylanica, WILD.*

The fibres of endogenous plants, the chief of which are enumerated above, are generally white if cleaned without fermentation, but are easily discoloured and also weakened by the decomposition of the mucilaginous and saccharine matter associated with them. Hence it is important that they should be cleaned either by mechanical or chemical processes as soon as possible after they are harvested. The resulting fibre, if of good quality, is white, bright, and glossy, and the individual filaments are straight and free.

Although grouped together here for convenience of treatment, the plants yielding these hemps require severally very different treatment under cultivation, and it is important to bear in mind that they will prove objects for remunerative culture only under certain special circumstances.

For instance, the Agave plants yielding Sisal Hemp flourish in the dry districts of Yucatan, they require little cultural attention, and the fibre is cleaned by means of cheap native labour, which is probably attainable in few Britith Colonies.

Manila Hemp is produced entirely in the Phillipine Islands from a species of wild banana or plantain (*Musa textilis*). It requires rich moist forest land, and while in its native country it is found to be easily cultivated; it has been only moderately successful under cultivation elsewhere. Here again the industry is supported by an abundant and cheap labour supply, which enables the fibre to be cleaned by hand at a cheap rate.

Bowstring Hemp is scarcely an article of commerce at present, although locally it is used for many purposes, as in Ceylon, India, and the East and West Coasts of Africa, where species of Sansevieria are found.

Mauritius Hemp is obtained from *Furcræa gigantea*, known in the island as *Aloës vert*, but elsewhere as the green or fœtid aloe. It is a large unarmed species, native of tropical America, but found in both the East and West Indies and also at St. Helena. At Mauritius it has established itself spontaneously on abandoned sugar estates. It is easy of cultivation, and partakes much of the character and habit of the plants yielding Sisal Hemp. Machinery has been used for preparing Mauritius Hemp, and while good prices ruled the industry was fairly remunerative.

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* These will be discussed in Bulletin No. 4 for April.

V.—SISAL HEMP.

Under this term are included fibres derived from probably more than one species of Agave, and it is probable also that one species of Furcraea is used. According to the locality where the industry is carried on or the port of shipment the fibre produced in Yucatan is called Sisal Hemp, which is the recognised name in the English market; or Jenequen or Henequen Hemp, which would appear to be the term more commonly used in the United States. Pita is another Central American fibre, but whether the produce of an Agave (*A. americana*) or of a Bromeliad (*Karatas Plumieri*) is not quite clear. Probably it is loosely applied to both.*

As regards the species of Agave yielding Sisal Hemp Miller first described *A. rigida* (Dict. Ed. 8, 1768) in the following words: "Long, "narrow, stiff leaves, entire, and terminated by a stiff black spine. "These leaves are seldom more than two feet long, little more than an "inch broad, being of a glaucous colour. The side leaves stand almost "horizontally, but the centre leaves are folded over each other and "enclose the flower-bud."

This may be accepted in a large sense as the representative species of which there are several sub-species and varieties cultivated by the natives of Yucatan from time immemorial.

According to Dr. Engelmann (Trans. Acad. Science, St. Louis, Vol. III., Dec. 1875) a common native species in Yucatan called Chelem by the aboriginal inhabitants is identical with *Agave rigida* of Miller; but a number of varieties, characterised by longer leaves or the absence of spines, have been recognised, to which names more or less distinct are now applied.

Mr. Baker has given a Synopsis of the Genus Agave in the *Gardener's Chronicle* (Vols. VII. and VIII., New Series, 1877). The plants mentioned below are included under the group *Rigidæ*, having the edge of the thin horny leaf without any distinct border, and the teeth (when present) small but distinct and deltoid. He remarks that this is a considerable group of which *A. lurida* and *A. rigida* may be regarded as the types intermediate between the groups *Americanae* and *Aloideae*.

From a study of plants at Kew, Mr. Baker was inclined to look upon *A. Ixtli*, Karw., as the type and *A. rigida*, Mill., *A. elongata*, Jacobi, and *A. Sisalana*, Perrine, as syonyms or varieties. But as in the first place *A. rigida*, Mill., has the priority in point of time, and (if we follow Dr. Engelmann) also represents the old aboriginal fibre plant of Yucatan (the Chelem), it would be better to retain this as the aggregate species and place the others among the varieties which have arisen in course of long cultivation in different parts of the peninsula of Yucatan.

We have then,

A. RIGIDA, *Mill.*

var. 1. *A. Ixtli*, Karw.; *A. ixtlioides*, H.K leaves 1½–2 ft. long, teeth distant.

2. *A. elongata*, Jacobi: leaves 4–5 ft., glaucescent and toothed.

3. *A. Sisalana*, Perrine; leaves 4–6 ft. long, pale green not glaucous, generally without teeth.

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* According to Miller Pita fibre is derived from *Furcræa gigantea*, which would make it identical with Mauritius Hemp. Dr. Perrine on the other hand mentions *Agave Ixtli* "as furnishing a fine fibre called Pita."

Dr. Engelmann in his notes cited above mentions that the original plant of *A. rigida*, was, according to Miller, brought from Vera Cruz, but his own specimens were collected in Yucatan by Dr. Schott. He states that Dr. Perrine, and Dr. Schott independently studied and described in Yucatan this interesting plant, with its different forms and economic uses (Senate Doc. 300, Washington, March 12th, 1838; the latter in the Report of the Agricultural Department at Washington for 1869. According to Dr. Engelmann, "both agree that there is a common "native species in Yucatan, called *Chelem* by the aboriginal inhabitants; "but from time immemorial a number of varieties, all characterised by "much longer leaves, and one also by the absence of marginal spines, "and differing among themselves in the quantity and quality of their "fibre, have been cultivated by the natives of Yucatan, and are a staple- "product of that country to this day, furnishing the well-known Sisal "Hemp. The people know them as *Jenequen* (Schott) or *Henequen* "(Perrine), and distinguish, as Dr. Schott reports, the *Yaxci* (Yashki) "as furnishing the best quality, and the *Sacci* (Sacqui) with the largest "quantity of fibre. *Chucumci*, larger than the last, produces coarser "fibre; *Babci* has fine fibre, but in smaller quantity; *Citamci*, with "small narrow leaves and poor fibre, stands probably nearest to the "wild plant. Dr. Perrine mentions another variety, *Istle*, evidently "the *Ixtli* of Karwinski, as furnishing a fine fibre called *Pita*. "These plants yield a return of leaves when four or five years old, "and may last 50 or 60 years under proper management; the flower- "ing scape is cut off as soon as 4 feet high, when, evidently, auxiliary "branches continue the growth of the plant, which is thus kept so "long alive by being prevented from flowering.

"The trunk of the wild plant of Yucatan, which I refer with little "doubt to Miller's old *A. rigida*, is 1–2 feet high; leaves 1½–2 feet "long, and as many inches wide, contracted above the broader base "and widest about the middle; lateral teeth ¾ or even 1 inch apart, "mostly straight, from a broad base 1–2 lines long, rather unequal, "with smaller ones interspersed, dark brown; terminal spine 1 inch "long, 1¾ lines in diameter, straight, or often somewhat twisted, terete, "scooped out at base but not channelled, dark red-brown, a dark "corneous margin extending down the leaf-edge for several inches and "bearing the uppermost teeth. Scape 12–15 feet high; flowers pale "yellowish green, 2¼–2½ inches long, perigone 16, tubes 6–7, lobes 9–10 "lines long; stamens inserted about the middle of the tube, 'blood-red "upwards,' 1-inch longer than the perigone; anthers 10–10½ lines "long; styles at last as long as stamens.

"*A. Ixtli*, which in 1872 flowered in the gardens of the late M. "Thuret at Antibes, is entirely similar, flowers of the same dimensions, "anthers a little larger (11½ lines long); capsules, which grow with "the bulbs on the same panicle, oval, over 2 inches long, 1¼ wide, very "short stipitate; seeds uncommonly large, 4½ lines high, with a ventral "hilum (in many other Agaves I find the hilum more basal, a charac- "ter which may be of some value). I believe this is the first time "that the flowers of the Ixtli have been described; * they identify the "plant with the old *A. rigida*, or at least the above-described Chelem. "*A. Karwinskii*, Zucc., is probably the same thing.

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* This remark made by Dr. Engelmann in 1872 is, however, not quite correct. The *ixtlioides* form (*Agave Ixtli*) were fully described and figured by Sir J. D. Hooker, from a plant which flowered at Kew in 1871. (Bot. Mag. t. 5893.)

"With the name of *longifolia* I designate the variety known as
" *Sacci* (Sacqui) and extensively cultivated in Yucatan; it is princi-
" pally distinguished by its much longer spiny leaves, 4–5½ feet long,
" 3–4½ inches wide; flowers very similar to those of the wild plant,
" but filaments greenish. *A. fourcroyoides*, Jacobi, Agav. p. 107, pro-
" bably belongs here, and *A. elongata*, Jacobi, p. 108, I would also refer
" to this form if the description did not expressly mention a channelled
" terminal spine.

"*Agave Sisalana* is the name that Dr. Perrine gave to the plant
" known to the natives of Yucatan as *Yaxci*, the most valuable of the
" fibre-producing Agaves, which was introduced by him into South
" Florida some thirty-five or forty years ago, during his efforts to accli-
" matize commercially valuable tropical plants in that almost tropical
" portion of our territory, efforts which were aided by Congress by a
" large grant of land, but which were destroyed, together with his own
" life, during the subsequent Indian wars. With this Agave, however,
" he has been successful, as it is now fully naturalized, and is quite
" abundant at Key West and the adjacent coast. Dr. Parry found it
" there in full bloom in February 1871, and gives the following des-
" cription of it: trunk short; leaves pale green but not glaucous, 4–6
" feet long and 4–6 inches wide, generally smooth-edged, but here and
" there bearing a few unequal, sometimes very stout and sharp teeth;
" terminal spine stout, often twisted, purplish-black; scape 20 or 25
" feet high, panicle 8 feet long and half as wide. One of the largest
" plants examined had 35 branches in the panicle, the largest (near the
" middle) 2 feet long, upper and lower ones shorter. The flowers are
" slightly larger than those described, with a shorter, thicker ovary,
" stamens inserted a little higher up in the tube. The plants bore no
" fruit, but produced an abundance of buds, by which they propagate
" themselves and from which this interesting form has been multiplied
" in this country and in Europe.

"If this plant is, as is most probable, only a cultivated variety of
" *A. rigida*, it is of the greatest importance for the study and the
" understanding of the Agaves, indicating, as it does, the extent of
" variation which they may undergo. It shows that the size of leaf
" and scape, or colour of leaf, are of no great specific value, and also
" that the presence or absence of spiny teeth on the margin is not an
" unalterable character, not any more than the cartilaginous margin
" decurrent from the terminal spine. The presence of a trunk, the
" proportions of the leaf (in *A. rigida* and all its varieties the length
" equals 12–14 times the width), probably the form of the terminal
" spine, the character of the inflorescence, and, above all, the form and
" proportions of the flower and its parts, remain constant, and perhaps
" also the proliferous character of the inflorescence of some species."

In a Report on fibre plants prepared by the late Director of the Botanical Department, Jamaica, in 1884, it is mentioned that with regard to the value of *Agave rigida* and its allied forms as the sources of the Sisal hemp of commerce, there are two important points deserving attention. The first is the universal increasing demand which exists in all countries for this fibre, and the second is the drought enduring character of the plant and the simple and economical treatment which it requires at the hands of the cultivator.

The fibre of these Agaves under their own name or as Sisal hemp and Henequen is quoted at the present time at 38*l.* per ton, which is a little over 4*d.* per pound.

In Yucatan the Agaves are planted about 9 feet between the plants each way, with intervals of 15 or 18 feet at certain distances for carting out the leaves and young shoots. In regularly planted areas there should be 400 plants to the acre. Plants put out as suckers about $1\frac{1}{2}$ to 2 feet high commence to yield in the fourth or fifth year and they "continue to do so for fifty or sixty years and even longer."

As an example of what the probable returns may be from a Sisal hemp plantation, it is stated by Dr. Perrine that each plant at four or five years old yields on an average 25 leaves per annum, the aggregate weight of which is one "arroba" or 25 pounds. Out of this weight of green leaves there is obtained by hand scraping one pound of clean marketable fibre, which at 38*l.* per ton is worth a little over fourpence per pound.

The annual gross return per acre may therefore be set down at 400 pounds of fibre, which at 4*d.* a pound, gives a gross yield of 6*l.* 13*s.* 4*d.* The actual cost of producing and preparing the fibre would vary according to the circumstances of the locality; but where ordinary facilities exist for the transit and preparation of the leaves, and especially with the aid of simple and effective machinery, the cost should not exceed one penny per pound. Hence the net returns may be set down at about 5*l.* per acre per annum.

The export of Sisal hemp exceeds that of any other article of Mexican growth. The export value of fibres from Yucatan in 1883 reached the large sum of 658,000*l.*

Dr. Schott, in the Report of the Department of Agriculture, United States of America for 1869, remarks that "while other products of "Yucatan agriculture may occasionally have become unprofitable either "in consequence of adverse climatic features to which the peninsula is "subject, or through commercial fluctuations, the Sisal hemp has never "been subject to such drawbacks, a fact attributable to the universal "usefulness of its fibre and the unconquerable vitality of the plant, "which easily survives the effects inherent to the nature of a riverless "rocky desert, and the severe trials of a six months' tropical sun. For "a knowledge of the Sisal hemp plant," continues Dr. Schott, "its "culture and uses, Yucatan is indebted to the Maya Indians, the direct "descendants of those remnants of the Toltecs who, after the fall of "their empire in the valley of Mexico, emigrated to Central America "and Yucatan."

An account of the Sisal hemp industry in Yucatan has lately been published by the Government of Jamaica. This was furnished by Mr. Stoddard, who for a time was practically engaged in the industry. It contains information on some points not hitherto available. According to this writer the plant known locally as Sacqui (probably according to Engelmann, the variety *longifolia,*) is most generally cultivated. This is said to yield the largest quantity of fibre, which is characterised by flexibility, whiteness, strength, and weight. It has been already mentioned that Dr. Schott selected the *Yaxci* as furnishing the best quality, and the Sacci (Sacqui) the largest quantity of fibre. It is, however, generally agreed that the bulk of the fibre exported from Yucatan, and called from the former port of shipment Sisal hemp, is the produce of the Sacqui. The chief port of shipment now is Progresso.

The land which supports the fibre industry in Yucatan is of a gravelly, stony, and in some places of a rocky character. The plants thrive best and yield the largest amount of fibre in comparatively arid districts, only a few feet above the level of the sea. Moist land or rich land is considered unsuitable, for although the plants would grow in

the latter, the quantity of fibre yielded would be comparatively small. For convenience of carriage and general management level land is preferred.

Plantations are established by simply clearing the land of trees and scrub. Stumps are uprooted to give an even surface. Shade is a disadvantage. Plants are generally put out during the rainy season, at 12 feet by 6 feet (equal to 605 to the acre) in holes proportional to their size. All fibrous roots and lower leaves are removed before planting, to facilitate new growth. It is estimated to cost "four shillings and six-" pence per acre to line, dig holes, drop suckers, and plant." A well established plantation has an extensive system of roads all converging on the works, which latter are placed in as central position as possible.

After planting, the chief cultural operations are confined to keeping the fields clear of weeds, and removing suckers which grow around the parent plants. These latter are utilised to extend cultivation by being planted in nurseries, or are thrown away. Their removal is considered necessary to the success of the plantation.

A fibre plantation started with plants about $1\frac{1}{2}$ feet high, begins to yield in about three years after planting. Any appearance of the "pole," or flowering spike, is watched, and when 3 or 4 feet high it is cut out. Otherwise the usefulness of the plants for fibre purposes would cease.

The length of leaves cut for fibre should not be less than 3 feet; their ripeness is judged by the colour and by their position in the rosette. Consequently the outer leaves are always cut first, being the oldest. The harvesting of the leaves, which goes on all the year after once started, is effected in the following manner:—Men armed with suitable knives select ripe leaves, cut them close to the trunk, remove prickles from the edge, and point and make them up into bundles of 50 each. Thirty such bundles is a day's task. These bundles are put out on the edge of the cart road, and are taken up by drays, carrying 1,500 leaves to a load, to the works. Cutters, carters, and machinists are paid so much per 1,000 leaves.

The works are placed near a regular supply of water. The power of the engine and the number of machines required all depend on the size of the plantation. One fibre machine is stated to be required for every hundred acres of plants.

After the fibre has passed through the machine it is placed on a drying stand fully exposed to the sun and thoroughly dried. If it is desired to bleach the fibre to a high degree of whiteness it is left out all night and during the next day and carefully turned. The fibre is made up into bales by means of a screw or hydraulic press; care being taken to keep the fibre straight and prevent "fringes."

Each plant when matured yields 30 to 35 leaves per annum, and the return of hemp is at the rate of 1,000 to 1,200 pounds per acre, or about half a ton per acre per annum. The net return on a fibre plantation in Yucatan is estimated at between 4*l*. or 5*l*. per acre.

Plants received at Kew from Yucatan marked "Sisal Hemp" are now growing in the Succulent House No. 5, and lately an experiment was made to test the quality of the fibre yielded by them.

The fibre was extracted by Mr. W. E. Death's fibre machine, and the following report was received upon it from Messrs. Ide and Christie, fibre brokers, of Mark Lane:—

"We are in receipt of the parcel containing a leaf of *Agave Ixtli* and
" sample of hemp made from leaves grown in the gardens. These are
" most interesting to us, and we have much pleasure in reporting
" favourably on the hemp. The quality and strength are very satis-

" factory, while in respect of colour, lustre, and fineness of fibre your " sample is superior to the average Sisal hemp that comes to this " country. The value of this article is exceptionally high at present, " 27*l.* per ton in London. You will see from the statistics given in " enclosed circular that this material is an important one and is exten- " sively used both in England and America. It enters into competition " with Manila hemp and was regarded as an adulterant of the latter in " rope; but as its price is now nearly as high as that of Manila the " ropemakers have not the same inducements to mix the hemps."

VI.—MAURITIUS HEMP.

A hemp industry was started at the Mauritius to utilize the large number of plants of *Furcræa gigantea*, Vent., which had spontaneously established themselves on low lying lands near the sea coast. This is one of the oldest and best known species of *Furcræa*, and is now universally spread throughout tropical America and also in India, Ceylon, Mauritius, and St. Helena. The trunk below the rosette of leaves reaches a height of 2 to 4 feet. The leaves are 4 to 7 feet long, 4 to 6 inches broad at the middle, unarmed, bright green and channelled down the face. The scape or terminal flowering stem reaches a height of 20 to 30 feet. Like all the other Furcræas this species produces copious oblong bulbillæ in place of or in addition to flowers, which falling take root and reproduce the plant. It has often flowered under cultivation in England; the last time at Kew being the autumn of 1874.

A full account, with description, of the various species of Furcræa is given by Mr. J. G. Baker in *Gardeners' Chronicle* (1879, pp. 623, 624). *Furcræa gigantea* is figured in the Botanical Magazine, t. 2250: Wight Ic., tab. 2025: Decandolle, Plantes Grasses, t. 126.

Although *Furcræa gigantea*, known locally as *Aloës vert*, is the chief fibre plant in Mauritius, there is evidence that *Furcræa cubensis* is also found there as well as species of Agaves such as *A. americana* and others.

Bojer (Hortus Mauritianus, p. 353) mentions the *Aloës vert* (*Furcræa gigantea*) as common in 1837, and states "Croît sur la Montagne " Langue dans les endroits vides et les basilages des habitations dans " tous les quartiers d'île." He does not mention *Furcræa cubensis* at all, so the latter must be a later production. Plants of both species have been received at Kew from the Mauritius Botanic Gardens.

Furcræa gigantea is supposed to have been introduced from South America to Mauritius about 1790. It has evidently found a congenial home there, for without any effort on the part of man it has covered waste lands and abandoned sugar estates to such an extent as to lay the foundation of a considerable fibre industry. The leaves are often 8 feet in length and from 6 to 7 inches in breadth. The pulp of the leaves when crushed gives off a strong pungent odour, and hence this species is sometimes called the *foetid aloe*. The juice is strongly corrosive and soon acts upon wrought iron; it is said to produce less effect on cast iron, while it is practically inoperative on brass and copper.

The plant grows in all soils and up to an elevation of 1,800 feet above the level of the sea. It has, however, more generally disseminated itself on the lowlands near the coast, and on a few of the abandoned sugar estates that have become too dry for cane cultivation.

A fibre industry was started at Mauritius about 12 years ago when the wet or retting system was tried. The cut leaves were first passed through the rollers of a sugar mill and steeped in water for some days. The fibre was then washed and beaten out by hand in running water.

This process was soon found unsuitable as the fibre was discoloured and rendered weak; consequently it obtained comparatively low prices. Attention was then directed to extraction by means of *gratteuse* or scotching machines. Many machines have since been tried, and it is believed that the purely mechanical difficulties connected with cleaning the fibre have been for the most part overcome. The amount of fibre obtained from leaves of the *Aloës vert* was at the rate of 3 per cent. by weight of green leaves. The yield of fibre was at the rate of about 1½ tons per acre. A set of six machines driven by a steam engine of 8-horse power (nominal) cleaned 1,155 pounds of fibre per day, which is at the rate of 197 pounds for each machine per day.

At one time there were eight fibre or hemp companies formed with a total capital of Rs. 1,182,500. The total quantity of fibre exported in 1872 was 214 tons, of the value of 4,934*l.*, which would be at the rate of 21*l.*, 13*s.* per ton. In 1880 it had increased to 662 tons, which sold in England at 28*l.* to 32*l.* per ton. Some samples in 1882 sold as high as 38*l.* per ton. Since that time low prices have ruled, and this added to the fact that the cost of production was considerably increased tended to discourage the industry. It is evident the industry was first started to work off the leaves of self-grown plants which were ready at hand in great abundance. When these leaves were exhausted it remained either to wait until the plants were regrown or to procure supplies of leaves at increased cost from the surrounding country. This latter course being adopted at a time when the market value of fibre was low rendered the enterprise unremunerative. In the returns of 1885 we find that Mauritius hemp imported to this country amounted to 255 tons of the value of 39*l.* per ton. In Messrs. Ide and Christie's monthly circular, Dec. 1886, Mauritius hemp is quoted "in good demand" at 28*l.* per ton.

The following extracts taken from Mr. Horne's Report on the Agricultural Resources of Mauritius will sufficiently explain the circumstances under which the fibre industry was started and the causes which have operated to produce the present depression, which in the interest of the island it is hoped will be only of a temporary character :—

"The industry of extracting fibres from the leaves of the *Aloës vert* is
" by no means exhausted. There is ground for believing that it has
" yet a future in Mauritius. The fall in the price of this fibre in the
" European markets broke several local companies that were formed
" for the working of the aloe estates. There was far too much money
" invested in them for them to pay."

* * * * *

"On many of the estates self-sown plants abounded in great numbers.
" It was from the leaves of these that the companies made money and
" paid large dividends when the price of the fibre was good. The
" plants had grown naturally on the land, and their presence on it had
" not cost a cent. In such cases results materially differ from those of
" reaping the crops of regularly laid out plantations with low prices for
" the produce. The soil and climate of the localities referred to favour
" the growth of the plants in such a degree that little expense need be
" incurred in introducing it to new grounds. The plant produces
" plantlets in great abundance in this colony. These plantlets grow
" viviparously on the parent plant, and adhere to it till they have
" developed into almost perfectly formed plants. When the young
" plantlets drop from their parent they are perfectly fitted to stand by
" themselves. Excepting the want of roots they are perfect. The
" roots are emitted as soon as the plantlets come in contact with the
" moist soil, even when they are lying on the surface of the ground.
" It seems, therefore, that to increase this plant rapidly and cheaply
" over a given area, due advantage should be taken of its peculiarities

" and the facilities which it naturally affords for propagation and " increase."

At St. Helena *Furcræa gigantea* has been for some time under cultivation as an introduced plant. Experiments on a small scale have been carried on, and samples of fibre have appeared in the English market. (Report on Resources of the Island of St. Helena, Colonial Office, African No. 275, 1884.)

Messrs. Collyer and Co. reported in 1883 on fibre from St. Helena as follows :—

" Aloe fibre (*Furcræa gigantea*) St. Helena. Good length, full " strength, rather dull colour, generally well cleaned but with some " runners untouched and barky. Value 28*l.* to 30*l.* per ton. This " sample is very different in appearance from the *Furcræa gigantea* " of Mauritius, owing probably to differences of both growth and treat- " ment."

While on the subject of fibre from *Furcræa gigantea* it may not be inappropriate to say a few words as regards the merits of another species, *Furcræa cubensis*. This, as already pointed out, is possibly one of the plants under the name of *Cajun* from which some of the Yucatan fibre is obtained.

It differs from *F. gigantea* in that it has no distinct trunk, or a very short one, below the rosette of leaves. The latter are 3 to 5 ft. long, about 5 inches broad at the middle, bright green, rigid in texture, and armed with regular, hooked, brown prickles.

It is a native of tropical America and cultivated in most tropical countries. A variety of this plant—*F. cubensis*, var. *inermis*—is figured and described in Bot. Mag., t. 6543.

In addition to flowers it produces bulbils on the flowering scape, from which the plant is readily increased. The plant is common in Jamaica, and it is said that there " would be no difficulty in establishing there a large area under cultivation." The fibre is white, strong, and bright looking. It yields at the rate of 2·05 to 3·15 per cent. by weight of green leaf. From experiments carried on at Jamaica under a committee appointed by Government it was found that leaves of *Furcræa cubensis* weighing 366½ pounds yielded 28 pounds of green fibre, which when perfectly dry weighed 7½ pounds. This was at the rate of 2·05 per cent. by weight of green leaf. In the report of the Committee this plant and its fibre are described as follows :—

" Silk grass (*Furcræa cubensis*). Leaves 5 to 6 feet long, generally " armed with strong prickles, but sometimes unarmed or with few " prickles. Common in Jamaica and might be largely propagated at " once. Value of fibre—(*a.*) 28*l.*, good quality, but might be whiter ; " (*b.*) fairly clean, fair colour, value about 28*l.* per ton ; (*c.*) superior " to Sisal and worth 27*l.* per ton. A good fibre, not quite sufficiently " white in the centre."

The above plants constitute the chief species of Agave and Furcræa yielding commercial fibres.

It may be mentioned here that many Agaves yield fibre, but the fibre may, as in the case of the Jamaica Keratto, prove unsuitable for industrial purposes. The Brokers' Report on Keratto fibre was—" little " strength : not an even (but a curly) fibre : towy : value 12*l.* to 14*l.* " per ton."

Plants yielding true Sisal Hemp might be obtained from Yucatan in large quantities.

D. M.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 4.] APRIL. [1887.

VII.—MANILA HEMP.

(*Musa textilis, Nees.*)

This is one of the most important of cordage fibres, and the whole supply comes from the Phillipine Islands. The imports of Manila hemp to Great Britain amount to about 170,000 bales, and to the United States about 160,000 bales, equal to about 50,000 tons per annum. The fibre is yielded by a member of the banana or plantain family known locally as Abaca (*Musa textilis*), the apparent stem of which is made up of sheathing leaf stalks. The habit of growth and treatment of the plant under cultivation are identical with those so well known in the case of the common banana. The fruit of *Musa textilis* is green and hard and useless as food.

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1887.

Price Twopence.

From a report by Consul Honey, dated Manila, 10th April 1879, we gather that this plant thrives best in soils largely composed of decayed vegetable matter. Hence, freshly cleared forest land is essential. Hilly land, about 200 feet to 500 feet elevation, is considered more suitable than low-lying land, probably on account of drainage. The Manila hemp plantations are situated where there is a rich volcanic soil, and where the climate is hot and humid with a heavy rainfall. The plants suffer severely during drought. Although seed is produced plantations are usually established by means of suckers put out when about 3 feet high, and about 8 to 9 feet apart. These form a root-stock, from which numerous stems are successively produced. The land is cleaned of weeds about twice a year. The first crop is reaped at the end of the second year after planting; a full crop is not obtained until the fourth year. The yield is then continued for 15 to 20 years, after which the plantation is exhausted. The stems are fit to be treated for fibre just before they begin to flower. In stems that have been allowed to flower the fibre is said to be weaker and of less value. They are cut about a foot from the ground and the leaves removed. Each stem is then stripped or resolved into its component layers, and these are again divided into strips or ribbons about 3 inches wide. Usually each layer or leaf-sheath is divided into three strips. The outer layers contain a coarser and stronger fibre than the inner, while fibre from near the middle is of a fine silky texture, and capable of being utilised without spinning or weaving and made into articles of dress and ornament.

The method of preparing the fibre is very simple but effective. Each strip, in a fresh succulent condition, is taken up by hand and drawn deftly "between a blunt knife and a hard smooth board," which are attached to a light portable frame. This process, repeated several times if necessary, removes all the watery particles and pulp, and there remains in the hand of the operator a beautifully white and lustrous fibre. The fibre is thoroughly dried in the sun and afterwards packed in bales for shipment. Hemp not properly dried or exposed to rain becomes discoloured and loses strength. On the other hand, hemp from the outer layer of the stem is of a reddish colour, but is quite sound. It is a characteristic of Manila hemp that it readily absorbs moisture, and in an ordinary dry condition it contains 12 per cent. of water. In a damp climate it has been known to contain not less than 40 per cent. of water.

Cordage, ropes, and indeed everything made from Manila hemp can be easily converted into paper of excellent quality.

The cost of establishing a Manila hemp plantation in the Phillipines, including cutting down forest, cleaning and planting, is about 5*l.* to 8*l.* per acre. This does not include the cost of the land. After this the yearly expense of weeding and maintaining the plantation in full bearing is at the rate of 30*s.* to 35*s.* per acre. The yield during the fourth and subsequent years is at the rate of 400 to 700 pounds of dry hemp per acre. "A labourer working under pressure can clean nearly "20 pounds of hemp per diem; but as a rule the quantity cleaned by "one man working steadily, day by day, averages about 12 pounds." Usually two men work together, one cutting down the stems and splitting them while the other cleans the fibre. "At the current "value of hemp in 1879 one labourer's earnings were $7\frac{1}{2}d.$ to 8*d.* "per diem." Several attempts have been made to introduce machinery, but so far nothing has been so successful as the primitive method above described. It is essential that any machinery introduced should be of a light and portable character, and that it should clean the fibre at a cheap rate, without breaking it.

From these particulars it will be seen that the Manila hemp industry is, to a large extent, supported by special circumstances which happen to be favourably combined in the Phillipines, and hence there is produced an exceptional article in large demand at a comparatively cheap rate. The conditions of soil and climate may possibly be found elsewhere, but as a necessary adjunct to these, there must be an abundant and cheap supply of labour adapted to a rural industry.

A plant of Manila hemp (*Musa textilis*) may be seen in the Palm House at Kew. For the purpose of illustrating the industry there are very complete sets of exhibits in the Kew Museum, No. 2. These include the raw fibre, cables, ropes, twine, fine muslin fabrics, "haif stuff," and paper of all kinds, the latter being made from old Manila ropes.

The valuable character of the fibre yielded by *Musa textilis* has naturally drawn attention to it as a valuable industrial plant, and during the last 60 years it has been introduced to India and elsewhere for experimental culture. Plants of *Musa textilis* were cultivated at Calcutta in 1822; specimens were introduced to the Madras Presidency direct from the Phillipines in 1858; while at the Andaman Islands this fibre plant has been thoroughly established.

Experiments in India so far have shown that plants of *Musa textilis* can be successfully grown in many districts; but it is not yet clearly shown that the fibre can be cleaned so expeditiously and so cheaply as to compete successfully with fibre from the Phillipines.

After a systematic series of trials made by the Glenrock Company at Madras in 1885, it is stated that plants put out in 1864 grew well and yielded numerous shoots. 179 stems, weighing about 60 pounds each, were cut down for experimental purposes and passed through Death and Ellwood machines. These produced 159 pounds of clean fibre, or 1·49 per cent. of the green stem. The cost of cleaning the fibre was at the rate of 6*l.* per ton, while the fibre itself, described as "poor, weak, and flaggy, with some clean fibre of good colour," was valued in London at 10*l.* per ton; the best alone was valued at 25*l.* per ton. The minute upon this of the Government of Madras is that "unless much improvement both in the method and cost of production "of this fibre can be made, the cultivation cannot be made remunera-"tive."

Manila hemp plants have been introduced from Kew to Jamaica, and to other portions of the West Indies. In favourable situations they grow well; but not so readily as the ordinary bananas and plantains. As the fruit is valueless they can only be grown for the sake of the fibre and this alone does not appear to offer sufficient inducement to plant up large areas. Usually the return from a fruiting stem of the common banana or plantain would be from 6*d.* to 2*s.*, depending upon the size of the bunch. The return from the Manila hemp plant would according to experience in the Phillipines be about one pound of fibre, the local value of which would be only 2*d.* to 3*d.*

NOTE ADDED.—In the Kew Bulletin, No. 3, pp. 5 and 6, the prices there given for Sisal hemp, as indicated in the context, are not the present prices. The price current in the London market in December 1886 is given on p. 8 of the Bulletin quoted. As showing the average price per ton of Sisal hemp in London for the years 1879–1886 inclusive, we are enabled by the courtesy of Messrs. Ide and Christie, to give the following:—1879, 24*l.*; 1880, 27*l.*; 1881, 28*l.*; 1882, 28*l.*; 1883, 27*l.*; 1884, 21*l.*; 1885, 19*l.*; 1886, 21*l.* The average price for the three months ending March 31st, 1887, is 28*l.* per ton.

U 50821. 500.—12/87. Wt. 16.



PLANTAIN.

(*Musa sapientum, R. Br.*)

VIII.—PLANTAIN AND BANANA FIBRE.

(*Musa sapientum, R. Br.*)

In connection with Manila hemp some reference may be made to fibres produced by other species of the genus *Musa*. The late Director of the Botanical Department, Jamaica, discusses the subject as follows :—

"It would appear that the fibre of the ordinary plantain and of the banana "is valued at about 12*l*. or 15*l*. per ton. This it will be noticed is only "one-third the value of the best qualities of Manila hemp. There are "in both the East Indies and West Indies numerous wild species of "*Musa* which might yield good fibre, but so far none appears to have "been found equal to the plant yielding Manila hemp. The following "facts have been elicited by recent experiments. A banana stem just "after fruiting, cut as is usual with the country people, about 2 feet "above ground, and denuded of its foliage, weighed 108 pounds; this "being divided into three lengths of 2½ feet each and split longitudi-"nally into several pieces was prepared by beating and washing by "hand, and yielded 25 ounces of clean marketable fibre, which is at "the rate of 1·44 per cent. of the gross weight. The fibre of the "lower portion of the stem, as also the fibre in the petioles of the leaves, "was not extracted.

"A smaller banana, cut under similar circumstances, that is, 2 feet "from the ground, and denuded of its foliage, weighed 41 pounds. "This was divided into two lengths of 2½ feet each, and after being "split longitudinally into several pieces was prepared by hand, and "yielded 6¾ ounces of good clean fibre or at the rate of 1·02 per cent. "on the gross weight.

"At the Hope Plantation similar experiments were conducted with "banana stems which yielded very much the same results. Two "banana stems cut after fruiting, at two feet from the ground, and "denuded of their leaves, weighed 147 pounds. These yielded 33 "ounces of clean fibre, or at the rate of 1·44 per cent. on the gross "weight.

"From ordinary stems of banana, cut after fruiting at about 1½ to "2 feet above ground, a settler might easily prepare about 1½ pounds "of clear fibre, but if the stems are large, and if the whole length is "used as well as the petioles of the leaves, the amount of fibre might "be increased to 2½ pounds if not 3 pounds per stem.

"With plantain stems* the results are more satisfactory than with "the banana, both as regards the yield and the quality of the fibre.

"At the Castleton Gardens, a plantain stem weighing, when cut and "dressed, 25 pounds, was prepared in exactly the same manner as the "banana stems above described and yielded 7¼ ounces of clean fibre or "at the rate of 1·81 per cent. on the gross weight. At the Hope "Plantation a plantain stem weighing exactly the same, viz., 25 pounds, "yielded 9 ounces of clean fibre or at the rate of 2·25 per cent. on the "gross weight. The plantain fibre is whiter and finer than the banana "fibre, and it approaches more nearly to the fine glossy character of "the fibre of the Manila plantain.

"For purposes of comparison I had the fibre of a small stem of the "Manila plantain, which, cut at 6 inches above ground and trimmed,

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* It is to be understood that in these notes the plantain is what is used as a vegetable, while the banana is the soft sweet fruit seen on tables for dessert. In India the name plantain appears to be applied indifferently to both of these.

" weighed 10 pounds, prepared in the same manner as the banana and " plantain fibre, and the result was 3 ounces of a beautifully fine and " glossy fibre. This is at the rate of 1·87 per cent. on the gross weight.

" In Jamaica another plantain is known as the Abyssinian plantain, " *Musa ensete*, which is the largest species of this genus. It was " discovered by the traveller Bruce in Abyssinia, and is remarkable as " being represented on ancient Egyptian sculptures. Specimens of this " plantain growing at the Government Cinchona Plantations at 5,000 " feet have often leaves 20 feet long, the stem is about 8 feet in cir- " cumference at the base, rises to a height of 25 feet and weighs " probably about a quarter of a ton.

" Specimens of fibre prepared from this plantain are of excellent " quality. Taking a portion of the central stem about 4 feet long and " weighing 73 pounds, clean fibre, weighing 13 ounces, was obtained " by beating and washing by hand. This is at the rate of 1·16 per " cent. on the gross weight.

" This plant might be grown extensively for its fibre, and it should " prove valuable, but of course not equal to *M. textilis*, which is un- " approachable as a fibre plant."

It may be mentioned that samples of all the banana and plantain fibres noticed above are to be seen in the Kew Museum, No. 2.

From the same source we find that about 2,000,000 banana stems, after the fruit is gathered, are cut down every year in Jamaica, which are allowed to rot on the land without any attempt being made to utilise the fibre they contain. It is suggested that the merchants who purchase the fruit from the negroes should offer a small sum for clean and well-dried fibre, and take it in small lots as it comes to hand. The merchant might afterwards sort and pack the fibre and put it up in tightly compressed bales for shipment. Some such plan as this, suited to local circumstances, evidently offers the best means of starting a banana-fibre industry in the West Indies.

In the course of the energetic efforts made by Governor Sir William Robinson, K.C.M.G., to develop what are called "minor industries" at Trinidad, attention has naturally been directed to the utilisation of fibre from both the cultivated and wild species of *Musa*.

A "red banana," very commonly cultivated as a shade and fruit plant, and the supply of which is said to be almost inexhaustible, has been brought forward as a possible source of commercial fibre.

A sample of fibre prepared from this red banana was recently sent to Kew, and the opinion of Messrs. Ide and Christie obtained upon it. Their report, dated 29th October 1886, is as follows :—

" We think highly of this fibre, for which we consider there might " be a considerable demand, provided it could be produced of a better " colour. We are inclined to think its dull hue is probably the result " of inexperience in its treatment, either by allowing it to steep too " long in rather foul water or from the leaves being too old and " discoloured before treatment. The attention of preparers should be " directed to the production of a fibre of the bright natural colour of " the enclosed specimen of Manila hemp, and were quantities of the " new fibre produced of this appearance we think they would command " 24*l.* or 25*l.* per ton, to-day, in the London market. Colour is of " great consequence when fibres are used for the production of 'white " hemp' ropes. Of course in the manufacture of tarred rope colour " is of no moment, but the white 'hemp,' Manila, Sisal, and New " Zealand are seldom tarred."

It is quite possible that, in spite of many years of experimental trial, the fibres of the banana and plantain may not assume great commercial

importance. In that case attention might be turned in another direction, and they might be partly prepared on the spot and utilised for paper-making. But to compete successfully with esparto and wood-pulp the fibre or "half-stuff" of banana and plantain should be delivered in Europe at a cost not exceeding 4*l.* to 6*l.* per ton, depending on condition. For paper-making it might be sufficient to cut the stems into short pieces, and then divide them longitudinally into numerous narrow strips. These, after being passed between rollers to get rid of the water and mucilage, might be dried in the sun, and afterwards put up in compressed bales for shipment.

The whole subject resolves itself into a question of cost, and it can only be practically solved in countries like Demerara, Trinidad, and Jamaica, where several thousand acres are occupied by banana plantations, and where sufficient material lies close at hand to maintain a moderately large industry.

For some years considerable interest has been taken by the Government of Bengal in the subject of the utilisation of plantain stems for the manufacture of paper. In a report presented by Dr. King, Superintendent of the Royal Botanical Gardens, at Calcutta, he mentions:—"Since receiving these papers I have gone into the whole "matter with some care, and I now give you the results. Before "proceeding further, I wish to explain that in the following remarks "the term *plantain fibre* is used to designate the fibres of the various "kinds of plantain found wild and cultivated within the Indian "Empire, but does not include the fibre of the Manila plantain (*Musa "textilis*), which is a fibre of an altogether exceptional kind. The "fibre of the Manila plantain, usually known as Manila hemp, is one "of the most valuable fibres known, and is worth in London from "30*l.* to 40*l.* a ton, a price that takes it quite out of the range of raw "materials for paper.

"I have ascertained, by reference to a large English paper-maker, "that if it can be delivered cheap enough, plantain fibre would be "readily bought in England for paper-making. Quotations as to the "exact value of the fibre can hardly be given until a trial shipment "has been put on the home market. Esparto is the fibre against "which plantain fibre would be pitted as a raw material for the paper-"maker, and the price of the best Spanish esparto now (1883) stands "in London at about 10*l.* per ton. It is not likely that plantain fibre "would be so valuable as esparto, but it might bring as much as 7*l.* to "8*l.* per ton."*

It appears that the Bally Mills Company, near Calcutta, has for some time utilised the stem of the cultivated plantain for paper-making, and the results are said to be satisfactory. The company purchase the roughly dried stems from contractors who collect them from villages in the neighbourhood. The price paid by the mill is 3*s.* 6*d.* to 4*s.* per cwt. according to quality. In this instance the preparation of the fibre is very simple. The plantain stem is cut down after fruiting, and the outer sheathing portions are cut into strips and thoroughly dried in the sun. The leaves and central core being useless only about two pounds of rough fibre are obtained from each stem. By this rough mode of preparation the fibre is not freed from the cellular tissue, and although it can be utilised on the spot it is doubtful whether it could be exported in this state.

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* Spanish and Algerian espartos are quoted in London (Dec. 1886) at 70*s.* to 110*s.* per ton. The estimated value of plantain fibre must therefore be reduced to one half of the above.

An attempt was made in the latter part of 1883 to utilise the thousands of acres of wild plantains growing in the Chittagong Hill tracts, which it was thought might yield large quantities of fibre at cheap rates. It was found, however, that any attempt at crushing the stems in a fresh state entailed heavier machinery than could be easily moved from place to place, and the idea was ultimately abandoned without any practical results being achieved. In spite of this, however, Dr. King is of opinion that plantain stems in India will eventually become available as paper material, and considering the immense number grown for shelter, shade, and food purposes, the subject is of considerable importance, both to the people of India and to paper-makers.

IX.—PINE-APPLE FIBRE.

(*Ananas sativa.*)

A note may be added here on the fibre yielded by the leaves of the pine-apple plant. Although not at present in commercial use, this fibre has a future of considerable importance before it. It is finer and stronger than that yielded by any other plant and in the Phillipines, where the West Indian Ananas has become thoroughly naturalized, a beautiful fabric known as "pina cloth" is made from it. A rope of pine-apple fibre $3\frac{1}{4}$ inches in circumference bore a strain, at Calcutta, of 57 cwt.

There are several samples of fibre of a wild pine-apple (*Bromelia sylvestris*, Willd.) from the West Indies and Central America at Kew, but there is no record of their commercial value. A sample supposed to be from this plant was lately sent from Trinidad, upon which the brokers reported as follows:—"Not yet in commercial use, but destined, "we think, to a successful future; fine, soft, supple fibre, strong and "good colour, ample length; say 30*l.* per ton and upwards."

The fibre of the Jamaica pinquin (*Bromelia Pinguin*, L.) would appear not to be of high value. The plant covers hundreds of acres in the plains and lowlands of Jamaica, and an effort was made some time ago to prepare the fibre for commercial purposes. The report of brokers upon a sample of 90 pounds was as follows:—"A long towzelled weak "fibre, of bad colour, coarse, no strength, and only fit for breaking up. "Similar to St. Helena hemp tow, but not so good. We should think "12*l.* to 10*l.* per ton the utmost value." Several samples of this pinguin fibre, from Jamaica and elsewhere, cleaned both by hand and by machine, are to be seen in the Kew Museum, No. 2.

If the leaves of this plant were cut up, roughly dried, and placed in compressed bales, they might prove of value for paper-making. To establish this point it would be necessary to forward to England about half a ton of dried leaves in compressed bales, in order that paper-makers might be able to test them on a sufficiently large scale.

D. M.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 5.] MAY. [1887.

X.—BOWSTRING HEMP.

This at present is not an article in commercial use; but attention may well be directed to the capabilities of numerous species of *Sansevieria* for producing fibre of great value. Plants of *Sansevieria*, of which there are 10 or 12 species, are very abundant on both the east and west coasts of tropical Africa, which, indeed, may be looked upon as the head-quarters of the genus. One well-known species (*S. zeylanica*) is indigenous to Ceylon; and this and others are found along the Bay of Bengal, extending thence to Java and to the coasts of China. The leaves of these plants are more or less succulent and

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1887.

Price Twopence.

abound in a very valuable fibre, remarkable alike for fineness, elasticity, and for strength.

Usually the leaves are not more than $1\frac{1}{2}$ to 2 feet long; in some species such as *S. guineensis* and *S. cylindrica* the leaves attain a length of 3 or 4 feet: while in one species, native of tropical Africa, the leaves under favourable circumstances attain a length of 9 feet. In this species, for particulars of which and for samples of its fibre we are indebted to Sir John Kirk, G.C.M.G., Consul-General at Zanzibar, the quality of the fibre is exceptionally good. We have doubtless here a new fibre plant of great value.*

In the treatment of the leaves of *Sansevieria* by machinery, the great drawback hitherto experienced has been their comparatively small size, and the difficulty of cleaning the fibre contained in them in an expeditious and remunerative manner. These circumstances would not obtain in the case of the plant brought into notice by Sir John Kirk. Indeed, for moist tropical climates, as opposed to the dry, hot, and arid districts of Yucatan where the Sisal hemp is grown, this and *S. longiflora* if they are really distinct would be likely to prove of exceptional value as fibre plants.

It may be mentioned that all species of *Sansevieria* prefer a rich moist soil and a comparatively humid climate. They are essentially tropical plants and do not thrive in a temperature less than 60° Fahr. Under such conditions they grow rapidly and establish themselves permanently by means of large spreading fleshy rhizomes or underground stems. It is true they will grow in comparatively dry districts, and even in soils strongly impregnated with salt; but their growth under such circumstances is very slow and the leaves are seldom large enough to produce marketable fibre.

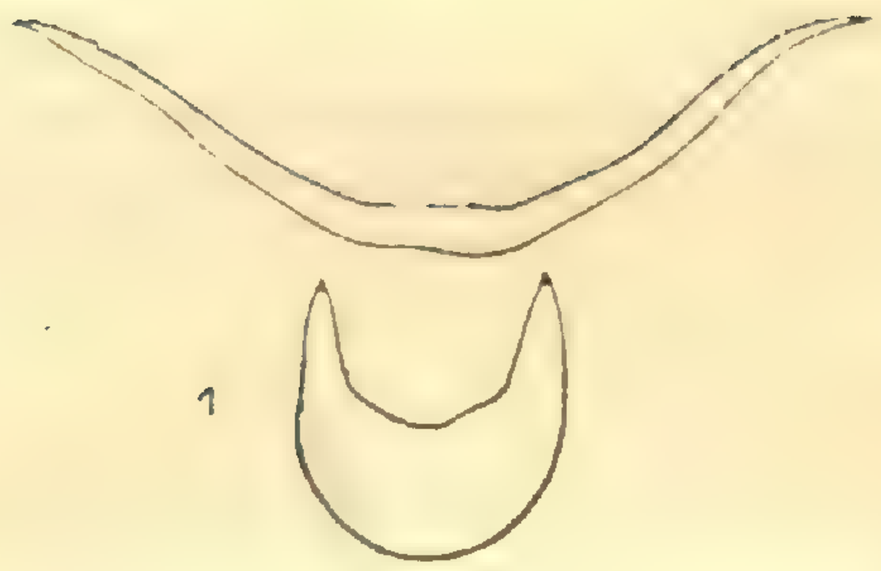
Dr. Roxburgh proposed that the fibres of Sansevierias might be called *Bowstring hemp*, because the natives of the Circars make their best bowstrings of them. On the other hand, small samples of fibre from *S. guineensis*, which have appeared in the London market, have been called African bowstring hemp. These fibres are very firm, hair-like and silky, and closely resemble those of the pine-apple; they are said to take dyes very readily; and the tow is mentioned by Royle to have been converted into good paper at Trichinopoly.

Plants of *Sansevieria* are already abundant in a wild or semi-cultivated state in most tropical countries. They are capable of being propagated very readily. Usually the underground stem or rhizome is divided and planted; but plants may also be raised from seed, or from the leaves, which latter, planted whole or cut into small pieces, readily take root in moist situations.

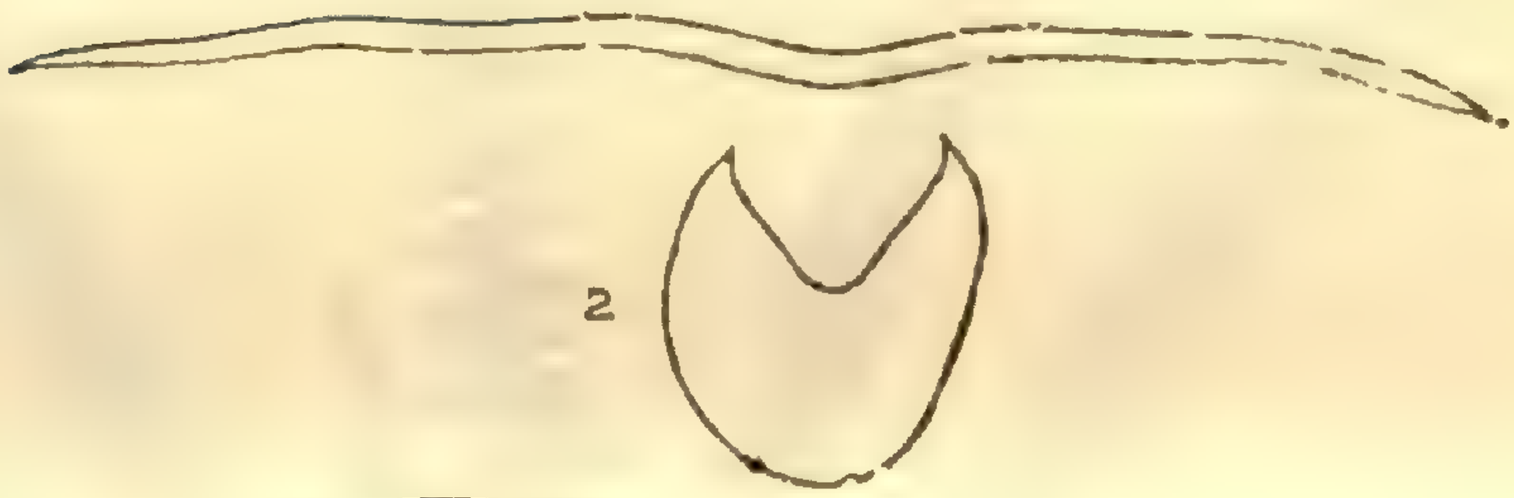
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* As to the identification of this plant Mr. Baker remarks as follows:—

"We have a specimen in flower from Buchanan, 'Shire highlands, Zambesia. Yields a most excellent fibre.' So far as can be judged by a rough sketch Sir John Kirk's is the same plant; and there seems no reason why it should not be identical with *S. longiflora*, Sims, in Bot. Mag. t. 2634, of which we have specimens from Guinea, Angola, &c."



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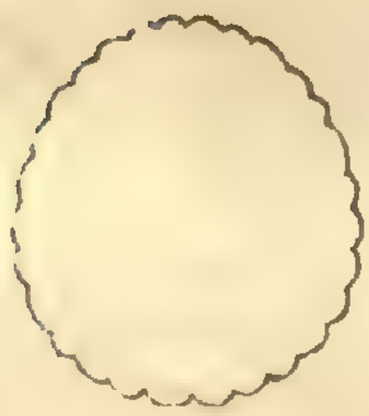
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Sections of leaves of species of *Sansevieria* :—

1. S. guineensis.
2. S. longiflora.
3. S. Kirkii.
4. S. thyrsiflora.
5. S. zeylanica.
6. S. cylindrica.
7. S. sulcata.

Note.—Where, as in Nos. 1, 2, 3, 4, two sections are given, the lower is from the base of the leaf, and the other exactly across the middle or widest part of the leaf. The sections here represented are nearly the natural size of leaves grown under cultivation at Kew. In the tropics under suitable conditions all the leaves would necessarily grow to a much larger size.

U 51023. 500.—12/87. Wt. 16. E. & S.



BOWSTRING HEMP.

Sansevieria zeylanica, Willd.

a. Flower laid open. *b*. Seeds.

A full botanical description of the several species of Sansevieria may be found in a monograph of the ASPARAGACEÆ, in the fourteenth volume of the *Journal of the Linnean Society*, pp. 546–550, by Mr. J. G. Baker, F.R.S. The description given in the following notes are contributed by Mr. Baker. The species are restricted to those which are now under cultivation at Kew, and of which specimens of fibre have been prepared and examined. The plants may be seen in the West Transept of the Palm House at Kew; while the specimens of fibres are in Kew Museum, No. 2.

The species, or well-marked sub-species, of *Sansevieria*,* of which we have living plants at Kew, are seven in number, and they may be readily classified according to their leaves in three groups, as follows:—

I. Leaves comparatively thin and flat:—

1. *S. guineensis.* 2. *S. longiflora.*
3. *S. Kirkii.* 4. *S. thyrsiflora.*

II. Leaves semicircular in transverse section at the middle, deeply hollowed down the face:—

5. *S. zeylanica.*

III. Leaves club-shaped, more like stems than proper leaves:—

6. *S. cylindrica.* 7. *S. sulcata.*

1. Sansevieria guineensis, Willd., is one of the two oldest and best known species. It was first figured and described, long before the days of Linnæus, in the year 1701, by Commelinus in his "Horti Medici Amstelodamensis Rariorum Plantarum Descriptio" (tab. 20), under the name of "Aloe guineensis radice geniculata foliis ex viridi et atro "undulatim variegatis." Linnæus classified it under the genus *Aletris* and so did Jacquin, who figured and carefully described it in 1770 in his Hortus Vindobonensis, vol. I., p. 67, t. 84. It has horny, erect, lanceolate leaves, 3 or 4 feet long, 3 inches broad at the middle, narrowed gradually to an acute apex, not distinctly bordered with red, copiously mottled on both surfaces with broad irregular bands of white. The flowers are in a lax, simple spike, which rises to the same height as the leaves, in clusters of three to six, with a whitish perianth about 2 inches long, of which the six segments are about as long as the cylindrical tube. It is a native of Guinea, from which we have wild specimens gathered by Barter and others. We have it also from Central Africa, collected by Schweinfurth and Grant, and Abyssinia by Beccari, and what is most likely the same from the Zambesi country, gathered by Sir John Kirk in 1860; the latter accompanied by a sketch made on the spot, when he was botanist to the Livingstone expedition.

On the Zambesi *S. guineensis* appears to be called "Konje," and Sir John Kirk speaks of it as "yielding a valuable fibre similar to Manila Hemp." It is described as "growing in great abundance in many places keeping to the shade of woods."

Mr. Horne, Director of the Royal Botanic Garden, Pamplemousses, mentions that—

"This plant thrives well in Mauritius in damp marshy places in the "lowlands. I have no doubt that it would thrive well in the wet "uplands."

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* As regards the spelling, following the Genera Plantarum, we have adopted Sansevieria, instead of Sanseviera as being the oldest name. Thunberg had it Sansevieria; Willdenow altered it to Sanseviera, and Kunth followed. Bentham in Genera Plantarum reverted to Sansevieria.

It is widely distributed in the West Indies, and has been grown experimentally for the sake of its fibre at St. Thomas, Jamaica, and Trinidad.

As regards cultural treatment, the following information is taken from notes prepared by the late Director of the Botanical Department, Jamaica, on this and *S. zeylanica* :—

"In the first instance plants may be put out at 3 feet by 3 feet, " which, allowing for roads and paths, would give about 3,000 to the " acre. If the soil is kept well broken and moist, these plants by the " extension of root suckers, will spread in all directions, so that ulti- " mately the whole ground, with the exception of certain paths, which " should be kept permanently open, will be covered with plants. As " regards the time which must elapse between planting out and the " first yield of leaves suitable for fibre, there would appear to be a great " difference of opinion. Plants which I saw at St. Thomas at three " years old were only just ready to be cut; and Baron Eggers, who " had planted them and kept them under close observation during the " whole of that time, was of opinion that Sansevieria plants could not " be depended upon to yield a crop before three or three and a half " years.

"My own experience coincides with this, but necessarily much must " depend upon the nature of the plants when first put out, the character " of the soil, the amount of moisture received, as well as on the system " of cultivation pursued.

"From actual trial tests in India, where one-third of an acre was " cultivated with *Sansevieria zeylanica*, it appears that full grown " leaves of three to three and a half feet long (their actual age is not " mentioned) yielded about 1 lb. of clean fibre for every 40 lbs. of " fresh leaves. That is, the weight of clean dry fibre was at the rate " of $2\frac{1}{2}$ per cent. of the fresh leaves. Dr. Roxburgh calculated that " one acre would yield 1,613 pounds of clean fibre at a gathering, two " of which may be reckoned on yearly, 'in a good soil and a favourable " ' season, after the plants are of a proper age.'

"This would be at the rate of $1\frac{1}{2}$ tons of fibre per acre per annum at " the end of three or three and a half years, of the gross value (at the " rate of 30*l.* per ton) of 45*l.* Whether this return can be depended " upon for the West Indies on an extensive area I am unable to say."

In an experimental trial carried on at Jamaica, 1,185 pounds of green leaves of *S. guineensis* yielded 29 pounds 10 ounces of dry fibre. This was cleaned by machine. The reports of brokers were as follows :—(*a.*) " Value, 18*l.* per ton, mixed fibre partly uncleaned;" (*b.*) "Poorly " cleaned, a good deal of mixture in it, not so strong, value about 25*l.* " per ton ;" (*c.*) "No good in the state sent; it has a lot of bark in it, " and requires more dressing; both ends are clean, but the centre is " dirty. Price, if dressed properly, would be as good as *S. zeylanica*, " viz., 30*l.* per ton."

In September last, His Excellency Sir William Robinson, Governor of Trinidad, forwarded to Kew, samples of fibre of this species, which he stated had been prepared "at the convict depôt at Chaguanas without " the aid of machinery of any kind." The report of Messrs. Ide and Christie on the Trinidad sample was as follows :—

"In point of cleanness and softness of fibre it seems well prepared; " but to compete successfully with Manila hemp it would require to be of " a better colour and of equal if not superior strength. We value it for " rope-making purposes at 20*l.* per ton in London. The small piece of

" Manila fibre which we enclose has a value to-day (Sept. 24, 1886), of " 31*l.* per ton."

A few leaves taken from plants grown at Kew were recently passed through Death's fibre machine, but the result, owing to the smallness of the quantity and the necessity of adjusting the machine to the size of each leaf, was not satisfactory, but it is not devoid of interest. The report of Messrs. Ide and Christie on the sample of fibre submitted to them was as follows :—" Short and only moderate strength. Value 23*l.* per ton. We " reported on fibre from this plant from Trinidad in September last, " when we valued the sample at 20*l.* per ton. The difference now is " due solely to the advance in the price of Sisal hemp."

Of samples of fibre of *S. guineensis*, the Kew Museums contain one specimen machine-cleaned from Jamaica, sent by Mr. D. Morris, 1884, with the following note :—" Leaves 3½ to 4 feet long, broader than *S.* " *zeylanica*, mottled, unarmed, common and easily propagated." A specimen from Trinidad, cleaned by hand, forwarded by Governor Sir William Robinson, and valued by Messrs. Ide and Christie at 20*l.* per ton. Also a leaf, rope, and fibre from S.E. Africa, sent by Mr. T. Baines. A specimen of leaf and fibre from Sir John Kirk appears under the following label, " Maculated Sansevieria, called 'Konje,' " near Lupata, 1860." This is probably identical with *S. guineensis*.

2. **Sansevieria longiflora**, Sims, a native of equatorial Africa, was first figured and described by Dr. Sims in 1826 at tab. 2,634 of the Botanical Magazine. The leaves are very like those of *S. guineensis*, but as grown with us, they are larger, flatter, not so firm in texture, and not invariably blotched with green. The best character by which it may be known from *S. guineensis* is the flower, which is 3½ or 4 inches long, instead of 2 inches. We have specimens in the Herbarium with flowers as large as this from Guinea gathered by Barter and Mann; from the Congo by Prof. C. Smith; from the Zambesi country by Mr. Buchanan; from Angola by the late Mr. Monteiro; from Niam-niam Land by Dr. Schweinfurth. Whether all these are the same species it is impossible to say at present. There is also a large flowered species, called *Sansevieria bracteata*, which was gathered by Dr. Welwitsch in Angola.

In 1879 Sir John Kirk forwarded through the Foreign Office a specimen of fibre from the leaf of a species of *Sansevieria* found growing on the mainland opposite the island of Zanzibar. The specimen sent was the produce of a single leaf, the length of which was 9 feet. The report of Messrs Noble on this specimen was as follows :— " We have carefully examined the fibre from East Africa; it is worth " as a hemp 22*l.* per ton at the present time" (1879).

Recently Sir John Kirk has been good enough to furnish more detailed information as regards the plant yielding this fibre, which leads us to conclude that it is probably *S. longiflora*, Sims. [*See* footnote, p. 2.] In a letter dated 2nd Dec. 1886 he mentions :—

" It grows abundantly near Pangane on the mainland opposite the " island of Zanzibar and in the district between that and Mombasa, and " is used by the natives to yield a long and useful fibre of which I sent " specimens to Kew some years ago.

" The plant has flowered with me at Mbwéni in the island of " Zanzibar, but the soil being too dry and sandy it did not succeed " very well.

" The flowers are on a stalk crowded in a head, not racemose, or in a " spike, as in another species common on the island. Unfortunately " my flowering specimens rotted in drying, so that I have never been

" able to send home the inflorescence for identification. The leaves " which yield the fibre are at first flat and clouded, but after a time the " lower part becomes much elongated, round and grooved on the upper " side, the end only remaining flattened and not so mottled.

" It is a plant worth being introduced to our tropical colonies."

Several plants of this species are growing in the Palm House at Kew, from which it would appear that it is a very free growing and robust species. Some leaves from these plants were lately tested for fibre by means of Death's fibre machine, which yielded at the rate of 1·69 per cent. of clean dry fibre. The report of Messrs Ide and Christie on specimens thus prepared was as follows :—" A very bright, clean, strong " fibre and in every way a most desirable commercial article. It would " compete with the best Sisal Hemp for rope-making purposes. Value " 30*l.* per ton."

There is little doubt that from the robust habit and size which this species is capable of attaining, that it is a most valuable fibre plant. As reported by Sir John Kirk, a single leaf of what we take to be the same species under favourable circumstances attains a height of 9 feet ; and from one such leaf excellent fibre weighing $\frac{3}{4}$ oz. has been produced. This and other examples of fibre are in the Kew Museum, No. 2.

3. Of **Sansevieria Kirkii**, Baker MS., we know the leaves only, but it is evidently a distinct species. It was sent to Kew by Sir John Kirk in October 1881 as a native of the east coast of Africa. We have had it in cultivation at Kew since that time, but so far it has not flowered. The leaf is oblanceolate in shape, and very horny in texture. We have only grown it to a length of 2 feet, with a breadth in the middle of 3 inches. The leaf is dull green, with a distinct brown edge, and is much mottled on both sides. The base is much thicker, and its edges are more incurved than in either of the three other comparatively flat-leaved kinds, and down the back of the lower part of a leaf run about five distinct grooves, a character which distinguishes it readily from *S. guineensis* and *S. longiflora*.

Specimens of fibre prepared from *S. Kirkii*, yielded at the rate of 1·69 per cent. by weight of the green leaf. They were described by Messrs. Ide and Christie as follows :—" Rather stout, but very clean and good " colour : the strength fair. Value 27*l.* per ton."

4. **Sansevieria thyrsiflora**, Thunb., is the species on which the genus Sansevieria was first constituted by Thunberg, in the year 1794. The leaf is nearly flat and does not reach above a foot or a foot and a half in length, and is an inch and a half or two inches broad at the middle, with abundant mottling and a distinct red edge. The flower does not differ from that of *S. guineensis*. It is a native of the eastern parts of Cape Colony. Zeyher gives the place of growth as " Uitenhage, in woods of " Zwartkops and many other places in the east of the colony ; *Kei* of " the Hottentots ; a decoction of the root used for dysentery."

The leaves of this species, growing at Kew, were too small to be tested for fibre.

5. **Sansevieria zeylanica**, Willd., is a very well known and well-marked plant. It is a native of Ceylon, and, long before Linnæus, was figured and described by Royen, Commelinus, and Pluknet. There are 8 or 10 leaves in a tuft and they are semi-circular in transverse section, 1 or 2 feet long, rounded on the back, deeply channelled down the face, $\frac{1}{3}$ or $\frac{1}{2}$ inch thick in the middle, in colour dull green, copiously banded with white, with a distinct red margin. The peduncle and flower spike are each about a foot long, the flowers being rather smaller than in *S. guineensis*, but quite similar in structure. It is well figured in Rédoute's

Liliaceæ tab. 290, and in the Botanical Register, tab. 160, in the year 1816.

In Ceylon this species is known under the Singhalese name of *Neyanda*. It is indigenous to the hotter parts of the island, and the fibre yielded by it is used in numerous ways, such as strings, ropes, mats, and of coarse kind of cloth. In India the plant is known as *Moorva*, *Moorga*, or *Marool*. Sir William Jones, in the Asiastic Researches, Vol. IV., p. 271, mentions *S. zeylanica* under its ancient Sanscrit name of *Moorva*, and he says that: "From the leaves of this "plant the ancient Hindoos obtained a very tough elastic thread called "Maurvi, of which they made bowstrings; and which, for that reason, "was ordained by Menu to form the sacrificial zone of the military "class." Dr. Roxburgh describes the plant as common on the jungly salt soils along the coasts, growing under the bushes, and easily propagated on almost every soil, from the slips which issue in great abundance from the roots, requiring little or no care, and not requiring to be renewed often, if at all, as the plant is perennial. The leaves, when thus cultivated, are from 3 to 4 feet long.

Mr. Horne makes the following note on this plant at Mauritius:—

"Several species of Sansevieria are common here in waste lands, near "the sites of old gardens, and by the road sides. They are not so "readily nor so cheaply established on land as the *aloës vert*. But they "yield a good fibre, which is used for cordage, &c. It has the reputa- "tion of being one of the strongest of fibres. It is known by the name "of *Bowstring hemp* and *Moorva*."

Generally in Ceylon and India the natives prepare fibre from this plant by retting or by simple beating and scraping. Full grown leaves yield at the rate of 7·87 per cent. by weight of the green leaves. Owing to the smallness of the individual leaves they are difficult to clean by machinery, but if it were possible to separate the fibre by a chemical process, this plant would become of great commercial value.

Of samples of *S. zeylanica* fibre the Kew Museums contain one specimen from Ceylon, sent by Dr. G. H. K. Thwaites, under the name of Neyanda fibre; one labelled Moorga or Bowstring hemp, from Jamaica, from Mr. D. Morris, 1884, with the following note attached: —"Longest leaves $3\frac{1}{2}$ to to 4 feet long, narrow, mottled, unarmed, very "common, and very easily propagated either by root, suckers, portions "of the leaf, or seed." There are also samples from the Botanic Garden, Mauritius, sent by Mr. Duncan; from Mysore, obtained from the India Museum, besides rope and twine from Balasore and twine from Cuttack, likewise from the India Museum; a Cingalese whip and nose strings for harnessed bullocks from Kandy, sent by Mr. J. A. Ferdinandus; a sample of paper half stuff from the India Museum; and some fibre, dyed in two colours (red and blue), from Madras, by Dr. Hunter.

Samples of fibre of *S. zeylanica* prepared at Jamaica by machinery, in 1884, were described as follows by London brokers:—(*a.*) "Beautiful "fibre, rather heavy and hard, might be whiter, value very uncertain, "20*l.* to 35*l.* per ton;" (*b.*) "Rather dull in colour and short in "growth, fairly well cleaned. Value about 30*l.* per ton;" (*c.*) "Might "be whiter. It is almost too good for roping purposes. Worth about "30*l.* per ton."

6. Of **Sansevieria cylindrica**, Bojer, an excellent figure and a full account by Sir William Hooker will be found at tab. 5,093 of the Botanical Magazine. It is a most distinct and curious looking plant. The leaves are cylindrical, round in horizontal section, faintly sulcate all

round, especially in the young state, obtuse at the end, arching, reaching when fully developed a length of 3 or 4 feet and a thickness of about an inch. The peduncle is about a foot long; the raceme much longer, with clustered cylindrical flowers just like those of *guineensis* in structure, but only about an inch long. It is spread across South Africa from Zanzibar to Angola. Our Kew plants were received by the Foreign Office from Angola in 1859 under the name of Ifé, and an abundant supply of its fibre and ship's cables and other ropes manufactured from it were shown in the Portuguese Department of the Paris Exhibition in 1858.

In the description attached to the figure of the plant in the Botanical Magazine mentioned above, Sir William Hooker adds the following particulars:—

"About three years ago (that is in 1857) there were received at the " Foreign Office, and transferred to the Admiralty, samples of a " peculiar fibre and cordage under the name of Ifé, said to be derived " from a new plant at the Portuguese Settlement, Angola, west coast " of Africa. These were accompanied by some apparently living " plants, which were placed in the cellars of the Foreign Office, and " by the kindness of our valued friend, G. Lenox-Conyngham, Esq., " forwarded to Kew, were they soon recovered, and have since " flowered. The habit of the plant was that of *Sansevieria*, but the " leaves very dark-coloured, and quite terete and solid in the interior, " very unlike any known species of that genus. My duties at the " Paris Exhibition of 1855 led me to the careful investigation of the " vegetable products, and I was there agreeably surprised to find most " extensive samples, in the Portuguese Department, of the raw mate- " rial fibre, and manufactured articles, ship-cables, rope, beautiful " cordage, &c., of the same material, and amongst 'The products of " Angola,' it is thus stated in my 'Report':—'*Fibre* marked, from *San-* " '*sevieria angolensis*, this latter being a MS. name of Dr. Welwitsch " 'for a remarkable species of *Sansevieria*, with long, stout, terete " 'leaves, which is in cultivation at Kew. The cordage and rope " 'made of this plant appear to the eye of excellent quality, whatever " 'experience may prove them to be.' Experiments recently made " with this cordage have shown it to be the strongest and best fitted " for deep-sea sounding of any fibre known; indeed this is the less " surprising, seeing that other species of *Sansevieria* (the well-known " *S. zeylanica* and *guineensis*, for example) are cultivated in almost " all tropical countries on account of the strength and durability of the " fibre, under the name of *Bowstring Hemp*."

Of samples of *S. cylindrica* fibre in the Kew Museums there is one specimen from Mauritius, sent by Mr. Duncan; fibre of the Probo and rope and cordage made from it, probably *S. cylindrica*, Sierra Leone, Commodore A. Eardley Wilmot, H.M.S. "Rattlesnake." The following note accompanies this specimen:—"Grows abundantly, can be " easily propagated." There is also a specimen labelled Mokhosi fibre and leaf, probably *S. cylindrica*, used for making cordage, &c., marked S. E. Africa, T. Baines, Esq.

Specimens of fibre prepared from plants growing at Kew, by Death's fibre machine, were described by Messrs. Ide and Christie as follows:— "This is the second best fibre amongst the samples sent, and except " that it does not appear as strong, it is almost equal to *S. Longiflora*. " Value 28*l.* per ton."

7. We have at Kew a dried specimen, as well as living plants, of **S. sulcata**, which appears to be an unpublished name of Boger's. The

plants, probably from East Africa, have never flowered, but in leaf character they are very similar to *S. cylindrica*. Under cultivation they are shorter and more slender, with rather deeper vertical grooves, but no bands or markings. A small sample of the fibre of *S. sulcata* was prepared, and the broker's report upon it was as follows :—"Similar to "fibre of *Furcræa cubensis* and of about equal strength. It is, however, cleaner, and would also compare with Mauritius hemp. Value, "26*l.* per ton."

It is quite possible that other species of *Sansevieria* may be found in tropical Africa, whilst some more more or less distinct may be under cultivation in colonial gardens. The illustrations given on page 3 of this Bulletin will assist in the determination of the species mentioned here. Specimens of any others will be gladly accepted for the Kew collections.

In his synopsis of succulent plants Haworth described briefly a number of additional species of *Sansevieria*, which are now lost to cultivation, so far as we are aware, and of which no figures or dried specimens are known. It is not improbable that there are many more types in existence than we possess materials for individualising or recognising at present. Of plants once in cultivation which Haworth briefly notices, we should be glad of information or specimens of the following: *S. lætevirens*, *S. ensifolia*, *S. glauca*, *S. polyphylla*, *S. grandicuspis*, *S. pumila*, and *S. fulvocincta*.

As regards machinery for the extraction of fibre from these plants the subject is one which lies outside the scope of the *Bulletin*. Machinery is in use in Yucatan and Mauritius for the extraction of fibre from *Agave* and *Furcræa* leaves, and machines are said to be made suitable for the treatment of leaves, of *Sansevieria* and others. We cannot do better, however, than refer to the literature given on this subject in Spon's Encyclopædia. Div. iii., pp. 923–930.

In the chemical extraction of fibres from plants there are several methods under experimental trial, some of which may prove ultimately successful.

D. M.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 6.] JUNE. [1887.

XI.—BOTANICAL STATIONS IN THE WEST INDIES.

Considerable interest and activity is being shown in the West Indian Islands in order to reduce as much as possible the depression into which they have fallen consequent upon the low price of sugar. Many of the fertile lands in these islands have been well adapted to the remunerative cultivation of the sugar-cane; but owing to the keen competition of beet sugar and to fiscal questions affecting its production, the price of cane sugar is now so low that this chief industry of the West Indies for the last hundred years is carried on under circumstances of extreme difficulty.

If improvements in cultivation were adopted, and if such high scientific skill as is applied to the manufacture of beet sugar were applied to the manufacture of cane sugar, it is the opinion of many that sugar-growing in the West Indies could still be remuneratively carried on.

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1887.

Price Twopence.

The object of this *Bulletin*, however, is not to reiterate the decadence of sugar, but to indicate the direction in which it would be wise and prudent to seek for means to alleviate the pressure of present circumstances. In islands differing so widely as regards soil, climate, conformation of surface, and elevation above the sea, in the number and character of population, and in local feeling and sympathy, it is difficult to generalise as regards the causes of failure in the past or of the remedial measures most likely to be successful in the future.

The spirit which now animates the people of the West Indies as regards the outlook of their industries is well expressed in a memorial forwarded to the Secretary of State by the people of St. Lucia, dated 20th April 1886. This memorial states :—

"That since the settlement of the island (of St. Lucia) the inhabi-
" tants have devoted their energies to the cultivation of the sugar-cane
" almost exclusively; the sugar industry having been found, with
" occasional fluctuations, fairly remunerative over an average of
" years.

"That causes have lately come into operation, the effect of which
" has been to reduce the price of the principal product of the Colony
" below the cost of production, and although the imminence of the
" danger which threatened them roused the people to make efforts by
" the importation of the most modern machinery, and the most
" approved scientific appliances for the economy of labour to secure
" the greatest outcome from sugar-cane; still but a small section of
" the people is in a position to take advantage of these means, the
" procuring of which necessitates an outlay of capital beyond the
" reach of the peasant proprietary class which forms the bulk of the
" producing portion of the population, and is the backbone of a country
" situated as ours is.

. . . . . .

"The people of St. Lucia are now eager to take up other economic
" plants, which are as yet unaffected by the causes which have brought
" about the depression in the cane industry, and the cultivation of
" which offers a reasonable prospect of profit.

. . . . . .

"It is our firm persuasion, therefore, that in the present critical position
" of the principal product of the island, and in the uncertainty which
" surrounds the future of the sugar industry, it is a matter of life and
" death to the Colony that other means of existence be at once brought
" within reach of the people, not only to avert an impending catas-
" trophe, but at the same time to lay the foundation of a more solid
" future prosperity."

There are at present in the West Indies (excluding British Guiana on the mainland of South America) six important Colonies. These are Jamaica, British Honduras, the Leeward Islands, with headquarters at Antigua, Barbados, the Windward Islands, with headquarters at Grenada, and Trinidad. These six Colonies have an aggregate area of 15,143 square miles, and a population in 1881 of 1,197,355.

In order to show the relative size and importance of these Colonies, the following table may be usefully consulted :—

Colony.	Area in Square Miles.	Population in 1881.	Revenue in 1885.	Chief Industries in order of importance.
			£	
Jamaica - -	4,193	580,804	595,156	Fruit, sugar, rum.
Turks Islands -	169	4,732	9,757	Salt.
British Honduras -	7,562	27,452	52,245	Mahogany, logwood, sugar, fruit.
Windward Islands—				
St. Lucia - -	237	38,551	38,493	Sugar, cacao.
St. Vincent -	147	40,548	23,857	Sugar, rum, arrow-root.
Grenada - -	133	42,403	41,894	Cacao, spices.
Tobago - -	114	18,051	10,825	Sugar, rum, cocoa-nuts.
Barbados - -	166	171,860	145,758	Sugar.
Leeward Islands—				
Virgin Islands -	57	5,287	1,753	Small produce.
St. Christopher -	68	29,137	41,243	Sugar.
Nevis - - -	50	11,864		
Antigua - -	170	35,244	41,957	Sugar, molasses, pine apples.
Montserrat - -	32	10,083	5,546	Sugar, lime-juice.
Dominica - -	291	28,211	15,841	Sugar, cacao, fruit.
Trinidad - - -	1,754	153,128	429,307	Sugar, cacao, cocoa-nuts.

The chief sugar islands at present are Barbados, Antigua, St. Vincent, Trinidad, and Tobago. Jamaica still produces sugar and rum to a large extent; but during the year 1886 the chief export of this island was fresh fruit, which was shipped to the United States of America to the value of 231,522*l.* The export of sugar was 202,791*l.*, and of rum 184,544*l.* At Trinidad cacao is largely grown, and the export value of this article is nearly two-thirds that of sugar. Coffee, spices, fibres, and fruit might very easily be added to the productions of Trinidad, and no doubt under the energetic administration of the present Governor, Sir William Robinson, K.C.M.G., steps will be taken in this direction. Grenada is in a comparatively prosperous condition, owing to the gradual supersession of sugar cultivation by that of cacao. Spices are also largely grown, and there are indications that this island, owing to the suitability of its soil and climate to the growth of nutmegs, cloves, cardamoms, pepper, and vanilla, will be known as the "spice island of the West." In 1885 Grenada exported 987 cwt. of spices, of the value of 5,526*l.* The area planted with nutmegs is yearly increasing. St. Vincent, possessing excellent natural resources, is in a lamentable state of decay, and produces chiefly sugar, rum, and arrowroot. Most of the land under cultivation is in the hands of a few persons, and hence land for small industries cannot readily be obtained.

Under favourable circumstances St. Lucia is well adapted to produce sugar, and if low prices had not ruled for so many years, no doubt an extension of plantations and the establishment of the *Usine* system would have raised this fertile and interesting island into an important sugar colony. At present, however, it has to fall back upon small industries such as cacao, coffee, spices, tobacco. The want of capital and ready means of communication between the interior fertile lands and the sea

seriously retards native enterprise, and prevents the growth of the prosperity which, however, it is felt, must come sooner or later to St. Lucia.

Dominica is third as regards size of the British West India Islands, but as regards utilised resources and general prosperity it is only a little better than Tobago. This is due to a variety of causes. The greater part of Dominica is still unopened virgin forest. The population is small and widely scattered. The old industries of sugar and coffee are in a state of decay, and no new ones have taken their places. Cacao, lime, Liberian coffee, fruit, and many other cultures are gradually being taken up, and the aggregate result of these, it is hoped, will in a few years bring prosperity to one of the most interesting of our possessions in the West Indies.

Antigua, like Barbados, is comparatively flat as compared with the other islands, and sugar plantations have been so largely extended over it that very little woodland is now left. Like Barbados, also, sugar is the chief industry in Antigua, and if ever new industries are established there, the process must be a very gradual one, and they will be only taken up when the remunerative growth of sugar has absolutely failed. Pine-apple culture is carried on to some extent, but both in the export of fresh fruit to England and the United States, and in canning it there is room for considerable expansion. Antigua would afford a good field for the experimental cultivation of fibre plants, and such plants as *Furcræa gigantea* and *F. Cubensis*, native to the West Indies, which support a fibre industry on the abandoned estates of Mauritius, should be largely planted. The sugar machinery might be adapted to the extraction of fibre, and the general level character of the surface would greatly contribute to reduce the cost of carting, and of all cultural operations. This subject, both as regards Sisal and Mauritius hemps, it may be added, has already been fully discussed in *Bulletin* No. 3, for March 1887.

Owing to the pioneering efforts of Messrs. Sturge, of Birmingham, Montserrat has become very favourably known for its lime-juice, the produce of the lime tree (*Citrus medica* var. *acida*), and in this respect they have benefited, not only this island, but many people in the other islands that have taken up the cultivation as imitators. Lime-juice is an article in limited demand; but it is hoped the Montserrat Company will extend its operations to other cultures for which the island is adapted, and so fully utilise the resources of this small but interesting island.

St. Christopher and Nevis are two islands lying closely together, united under one Government in 1883. The former is covered with green slopes of sugar-cane, sweeping all round the island towards the central cone, known as Mount Misery. It is fairly prosperous, owing to the number and character of its population. Nevis is also chiefly devoted to sugar growing, and it owes much of its importance to the enterprise of Sir T. Graham Briggs, Bart., who has spent enormous sums, not only in the endeavour to improve the character and efficiency of the sugar estates, but also to introduce other industries suited to the island.

The Virgin Islands, with a scanty population, are chiefly devoted to the cultivation of small produce by the peasantry, and to some rudely prepared sugar. Fibre plants are abundant, and might be utilised.

There only remain to be noticed two islands, viz., Barbados and Tobago. Barbados has hitherto been one of the most prosperous of the West India Islands, and with its teeming population, at the rate of

1,031 to the square mile, it is well adapted to carry on the careful and systematic cultivation of any plant suited to its soil and climate. Tobacco, fibres, arrowroot, aloes, are subjects receiving attention on a small scale, but nearly the whole of the land under cultivation is devoted to sugar-cane, and to growing sweet potatoes, the latter as an intermediary crop. What the future of Barbados will be, if it is compelled to relinquish sugar cultivation, it is difficult to see. The people are, however, so industrious and enterprising, and food is so comparatively cheap, that any industry well suited to the soil and climate has every prospect of success.

Tobago possesses what is known as the metayer system, in which the labour on sugar estates is supplied on condition of the peasants receiving the use of the land and of the mill for grinding, the owner receiving in return a certain fixed portion of the produce. Under such circumstances the cultivation is usually very poor and the system would appear not to be adapted to any other produce than sugar. As shown in the table on page 3, it is evident that within the area of 114 square miles at Tobago, free from hurricanes and destructive storms, there must be very favourable openings for the prosecution of small industries; and cocoa-nuts, fruits of various kinds, cacao, coffee, spices, arrowroot, ginger, and indeed most tropical products are capable of being added to the productions of an island which should be no less prosperous than the neighbouring islands of Grenada and Trinidad.

After thus briefly reviewing the individual characteristics of the Colonies included in the West Indian group, it is important to notice that with the exception of two islands, viz., Antigua and Barbados, it is estimated that one-half of the actual surface is better adapted for some other cultivation than that of the sugar-cane. This fact is an important one as bearing upon the possibility of embarking upon what are known as "minor industries," and it is evident that by too close an adhesion to the purely sugar-growing habits and methods, the people act injuriously to their best interests and neglect the numerous resources at their command.

In an article contributed to *Nature* by Mr. D. Morris, vol. xxxv. No. 898, pp. 248–250 (January 13, 1887) it is pointed out :—

"In purely sugar islands, such as Barbados and Antigua, permanent
" improvement is to be sought in more economic and improved systems
" of cultivation, added to which there should be a concentration of all
" purely manufacturing processes under what is known as the *Usine*
" system. This latter system is already in existence at Trinidad,
" St. Lucia, British Guiana, and in the French island of Martinique;
" and it is proved beyond question that where the manufacture of sugar
" is treated as a highly specialised industry, finer and better qualities
" are produced, and the expenses are considerably diminished. Plan-
" ters are therefore recommended to confine themselves as much as
" possible to the purely cultural operations of a sugar estate. Under
" such a division of labour there would follow a more careful trial of
" different varieties of the sugar-cane, adapted to the different soils, a
" more scientific application of special manures, and such general regula-
" tion of all cultural operations as would produce canes of the highest
" saccharine richness. In Barbados, Trinidad, and Jamaica, there are
" already Government analytical chemists who are qualified to give
" valuable information to planters as regards soils and manures; and
" from a report recently prepared at Barbados by Professor Harrison it
" is evident that much good would result from a larger ulilisation of
" chemical knowledge as applied to sugar cultivation, both in the
" interest of the individual and of the general community.

"During the last five or six years efforts have been made to increase
" the efficiency of West Indian industries by a wider and more general
" application of scientific methods not only to the sugar-cane but to all
" other plants which may be found suitable to the circumstances of the
" several islands. Hitherto two botanical establishments have been
" maintained for the West Indies, one at Jamaica and the other at
" Trinidad. From these centres, but especially from that of Jamaica,
" economic plants and information by means of annual reports and
" other publications have been regularly furnished, and such agencies
" have greatly assisted in enlarging the scope of experimental culture."

In the Report of the Royal (West Indian Finance) Commission, appointed in 1883, Paragraph No. 247, it was stated that there was a growing inclination on the part of the planters in other West Indian Colonies to apply for seeds and plants to the botanical establishment in Jamaica, which could supply each island with what it required in the most economical manner. Sir Joseph Hooker, commenting on this report, at the request of the Secretary of State, in a letter dated 26th January 1885, expressed the opinion that there could be no doubt that the future prosperity of the West Indies would be largely affected by the extension to other islands, unprovided with any kind of botanical establishment, of the operations so successfully pursued in Jamaica.

A systematic endeavour to promote cultural industries in the West Indies by means of small botanical establishments in each island connected with Jamaica has now been under consideration for some time. Speaking of the special character and scope of the establishments or stations which were intended to be maintained, at a small expense, in each of the islands, Mr. Morris, Director of the Botanical Department, Jamaica, offered the following suggestions in a letter addressed to the Colonial Secretary of Jamaica, dated 28th October 1884 :—

"Being supported by the Government, it is very desirable that a
" Government officer or a board appointed by Government should be
" in general charge of the proposed botanical station, and that all
" correspondence relating to it be carried on through such officer or
" board.

"As the results of a botanical station are so entirely dependent on
" its supervision and management, I would suggest that even if a
" board be formed for the general improvement of planting industries,
" the direct charge of the station should be left to some efficient Govern-
" ment officer who would have knowledge of plant life, and be able to
" devote a little time daily to its working and management.

"Possibly the Colonial engineer or the Crown surveyor would be
" able to do this in some Colony, while a member of the Colonial
" Secretariat would do it in others. Correspondence with and all
" requisitions for plants from the Botanical Department in Jamaica
" should invariably be carried on through the Colonial Secretary.

"For starting a botanical station a few acres of land in a sheltered
" and protected (fenced) situation, and within reach of water is the
" first requisite. A small potting and tool shed are all the buildings
" actually required, while bambu for pots, and banana leaves and
" 'wattles' for shading purposes can be had close at hand in most
" West Indian Colonies. The station as already mentioned should be
" near the seat of Government, close to the chief shipping port of
" the Colony, and well placed as regards communication with the
" interior.

"The chief points requiring attention as regards the supervision of
" the station are the regulation of working hours, the prompt treatment
" of seeds and plants immediately they arrive, the assignment of plants

" ready for distribution, and the due supervision of the station so as to " keep it in an efficient working condition for supplying the special " needs of the Colony.

" A small charge, sufficient to cover the cost, might be made for all " plants raised at the station; while for plants imported direct from " Jamaica the cost would necessarily include packing and freight " charges, &c. A regular schedule should be supplied to each station " of the cost of plants which can be supplied from the establishments " in Jamaica, which will include packing and freight. This schedule " might be periodically published in the Official Gazette for the infor- " mation of planters. Lists of seeds to be forwarded by post can also " be similarly supplied and published.

" It has been suggested by Mr. W. T. Thiselton Dyer, C.M.G., the " Assistant Director (now Director) of the Royal Gardens at Kew, " who takes a deep interest in this attempt to develop the latent " resources of the West India Islands, that in addition to distributing " plants there might be organised at the Central Institution a regular " system of botanical bulletins containing practical hints as to the treat- " ment of economic plants, and the conditions under which they might " best be utilised as objects of remunerative industry.

" There is no doubt a great want felt in the West Indies for reliable " information on the culture of new economic plants; and to ensure " success it will be necessary not only to supply seeds and plants, but " also carefully compiled and plain practical hints as to the means to " be employed for rendering them of the greatest value.

" It will, however, depend entirely on the several islands concerned " whether the scheme of botanical stations, with the wide distribution " of botanical literature as herein indicated, can be fully carried out; " but judging from what I know of these well-placed and well-favoured " islands, and from some five years' correspondence with the leading " planters in them, I know nothing better calculated to benefit them " under present circumstances, or to prove more likely to be of " permanent benefit to them."

At the instance of Lord Derby, Secretary of State for the Colonies, it was decided that the whole of the smaller West India Islands not already provided with botanical gardens be asked to co-operate in a systematic endeavour to promote and extend the cultivation of economic plants, and thus develop more fully than heretofore their natural resources. In a Despatch, dated 14th February 1885, the Secretary of State addressed the Governors of Barbados, Leeward Islands, Bahamas, and British Honduras, as follows:—

COLONIAL OFFICE to the GOVERNORS OF BARBADOS, LEEWARD ISLANDS, BAHAMAS, AND BRITISH HONDURAS.

" Colonial Office, Downing Street,
14th February 1885.

" SIR,

" I HAVE the honour to transmit to you a copy of a report by " Mr. Morris, the Director of Public Gardens and Plantations in " Jamaica, on the establishment of botanic stations in the lesser " islands of the West Indies, together with a copy of a letter from the " Royal Gardens at Kew, conveying the observations of Sir J. Hooker " on the proposals.

" I strongly recommend the adoption of the proposed scheme in each " of the Presidencies of the Leeward Islands except the Virgin Islands, " which cannot afford even this small expenditure, in each of the " Windward Islands, and in the Bahamas and British Honduras.

"As the Jamaica establishment can, with a certain amount of
" additional clerical assistance, undertake to communicate with and
" supply all the proposed botanical stations, I do not think it necessary
" that any of them should be connected with Trinidad.

" A contribution of 20*l.* a year from each Colony, Presidency, or
" Island in which a botanical station is established would appear to be
" sufficient to provide for the additional expense which the scheme
" would entail upon Jamaica.

" I have, &c.
" (Signed) DERBY."

As a result of deliberation in the islands concerned, the Secretary of State, Colonel F. A. Stanley, now Lord Stanley of Preston, was able to communicate their acceptance of the scheme in the following despatch addressed to the Officer administering Government of Jamaica :—

" COLONIAL OFFICE to OFFICER ADMINISTERING THE GOVERNMENT OF JAMAICA.

" Colonial Office, Downing Street,
" SIR, 9th February 1886.

" I HAVE the honour to acknowledge the receipt of your de-
" spatch No. 4 of the 6th ultimo, with reference to the proposal made
" in 1884, that botanical stations should be established in some of
" the West India islands in connexion with the Botanical Department
" in Jamaica.

" On the receipt of Sir H. Norman's despatch No. 473 of the 8th of
" November 1884, after consulting Sir J. Hooker, Lord Derby addressed
" to the Governors of the Windward and Leeward Islands, of Bahamas
" and British Honduras, an identical despatch, of which a copy is here-
" with enclosed, transmitting copies of Mr. Morris's letter of the 20th
" of October 1884, and recommending the adoption of the scheme in
" those Colonies.

" The Colonies and Presidencies named as follows:—Barbados,
" Grenada, St. Vincent, St. Lucia, Antigua, St. Christopher and Nevis,
" Montserrat, Dominica, British Honduras, are prepared to establish
" botanical stations and to provide 20*l.* a year each towards the
" expenses of the Jamaica botanical establishment carrying out the
" scheme.

" I trust that the Government of Jamaica will see its way to allowing
" this scheme to be carried into effect; and in that case it will be
" desirable that you should communicate direct with the Governors
" of Barbados, the Windward Islands, the Leeward Islands, and British
" Honduras.

" I have, &c.
" (Signed) F. A. STANLEY."

Consequent upon a change in the directorship of the Department at Jamaica, and the prolonged quarantine regulations maintained against Kingston at Barbados, it was impossible to place the scheme in operation at once. At Grenada, however, a small botanic garden is in course of being established under the charge of Mr. W. R. Elliott, formerly of the Botanical Department, Jamaica, who has issued a first report on the work already done; while under sanction of an Act of the Legislature, a sum of 100*l.* was granted to establish a botanical station at

Dodd's Reformatory, Barbados. In a letter, dated 6th July 1886, addressed to the Colonial Office, the Assistant Director, Royal Gardens, Kew, referred as follows to the Barbados station :—

"When at Barbados in March last I visited Dodd's Reformatory, at "the invitation of the committee appointed by the Government of "Barbados to supervise its management, and gave assistance in "selecting a piece of land for the purpose of being laid out as a "nursery for economic plants in connexion with the proposed botanical "station.

"At the same time I was shown the area of nearly 90 acres in "extent, upon which the sugar-cane experiments were being con-"ducted, and was impressed not only with the suitability of the "locality for the purposes in view, but also with the zeal and capability "of Professor Harrison, Chemist to the Agricultural Society of Bar-"bados, and Mr. Bovell, the Superintendent of the Reformatory, who "evidently had entered upon the experiments with aptitude and "knowledge of a special character.

"Although this is the first year of the experiments, the report "presented to the Government of Barbados is given in the current "number of the 'Sugar Cane,' and also with more complete tables "in the 'Barbados Agricultural Gazette' for June 1886. It is a "valuable contribution to sugar-cane literature, and deserves special "notice.

"It will be observed, on a perusal of this report, that the chief "points sought in the experiments were, first, the influence of some "21 different kinds of manures on the growth by weight of canes "isolated in different plots; and, secondly, the influence of these "different manures in producing a certain number of pounds per acre "of crystalline sugar.

"It would appear from these experiments that sulphate of ammonia, "by many believed to be an excellent manure for sugar-cane, is "practically worthless when used alone, but very valuable when used "with the addition of either superphosphates or potash salts. Farm-"yard manure, when obtainable, is evidently the best of all manures "for sugar-cane, and gives relatively a larger yield of crystalline sugar "than any other.

"There are many other points upon which it is possible to dwell in "this report, but as Professor Harrison and Mr. Bovell hope to carry "on these experiments from year to year, there are good grounds for "hoping that an advance will be made in the treatment and cultivation "of the sugar-cane, and it is for those who believe that the future of "the sugar-cane depends upon the scientific improvement of its agri-"culture to carefully watch such experiments, and turn them to the "best advantage as their several circumstances will allow."

At St. Lucia consequent upon the approval of the Secretary of State of a vote of 300*l.* in its support, a botanical station is being established near Castries under Mr. John Gray, lately of Jamaica, "an experienced "horticulturist, and a man calculated to be of great service in diffusing "horticultural knowledge amongst the people of St. Lucia." This station is supervised by a committee appointed by the Government.

At Dominica, Antigua, Montserrat, Nevis, and St. Kitts, so far, stations have not been started, but it would appear that interest in the scheme has by no means failed. If Dominica had been in a more prosperous condition, it might have been possible, as suggested by Dr. H. A. Alford Nicholls, to establish a central botanical establishment there for the whole of the Leeward Islands. Already, owing to the keen interest taken by the late Dr. Imray, and latterly by Dr. Nicholls

himself, a large number of very valuable plants have been established at St. Aroment, which might provide the means for supplying a botanical garden with seeds and plants at a small cost. Many of these plants have been sent out from Kew in exchange for Dominica plants established and forwarded by the unaided efforts of the two gentlemen above-mentioned. The site of a garden might be obtained within easy reach of the town of Roseau; and there are few men in the Leeward Islands possessing better knowledge and a keener interest in economic plants than Dr. Nicholls, who is evidently willing to assist as far as possible in establishing a botanic garden in an island likely to benefit so largely by it as Dominica.

Perhaps no island requires more assistance in the prosecution of small industries than St. Vincent. This island formerly possessed a botanical garden, which, however, was removed to Trinidad about 60 years ago. The following particulars respecting the old botanic garden at St. Vincent are of special interest in view of the effort now being made to revive it.

"This garden was established in 1764. It is situated in a small " valley, about a mile from Kingstown, where 40 acres of land are " still the property of the Crown, and where the Lieutenant-Governor's " residence is situated. Of these 40 acres, about one-third was devoted " to the garden, the rest being waste.

" Superintendents, at liberal salaries, were from time to time sent out " from England, and much care and labour were expended by the " Imperial Government upon it. The superintendent employed 12 " negroes.

" That its success attracted due notice in England is gathered from " the fact that Dr. G. Young, the first superintendent whose name is " recorded, received in 1772, from the Society of Arts, a gold medal, " in recognition of the flourishing state of the garden.

" Valuable contributions were made from distant countries, from the " East Indies, from South America, and from the Pacific Islands. In " 1793 Captain Bligh introduced the breadfruit from Tahiti, leaving " here 300 plants. This valuable fruit is now common in St. Vincent. " Nutmeg, cinnamon, cloves, and allspice were also planted in the " island. A number of fine nutmeg trees still attests the care originally " bestowed upon them."

At the request of the Secretary of State, the following memorandum was recently prepared (18th February 1887) by the Assistant Director, Kew, relative to the steps to be taken to give practical effect to the scheme of botanical stations in the West Indies:—

" To set the scheme in operation it is necessary in the first place that " the Government of Jamaica (in accordance with the terms of the " Secretary of State's Despatch, 9th February 1886) communicate its " acceptance of the scheme, and the date when the Jamaica Botanical " Department will be ready to act, to the Governors of Barbados, the " Windward Islands, the Leeward Islands, and British Honduras.

" Seeds may very conveniently be distributed by pattern and parcel " posts; but the transit of plants is a subject which requires special " consideration, and arrangements will have to be made for carrying " them at cheap rates and in a careful and successful manner.

" In my recommendations on botanical stations (*see* paragraphs 22 " and 23, letter No. 558, 28th October 1884) I mentioned that freight " rates on cases of plants carried inter-colonially by the Royal Mail " Company's steamers were practically prohibitory.

" Although twice reduced at my urgent request they are still so " high as to amount to more than the original cost of the plants. A

" representation might be made by the islands concerned to the " directors of the Royal Mail Company to carry all economic plants " calculated to lay the foundation of new industries free of charge. " A concession of this character has been made and carried out by " the P. and O. and other eastern steamship companies for many years.

"A similar concession made in the West Indies would give a great " impulse to the distribution of plants and reduce the cost at which " they might be distributed to the several botanical stations.

"Action on this point would more appropriately come from the " Agricultural Societies of the several islands and not from Govern- " ment. But it is a subject which very intimately concerns the success " of the botanical station scheme, and should, if possible, be settled " before the scheme is placed on its trial.

"An occasional bulletin, containing hints as regards new industries, " list of plants for distribution, and any general information affecting " the relations of the central establishment to the stations is an im- " portant feature in the scheme. Arrangements might be made to " issue such bulletins, or at least a preliminary one, as soon as the " director of the Botanical Department at Jamaica is prepared to set " the scheme in operation.

"The cost of printing the Bulletin would be defrayed out of the " contributions of the several islands, and they might be forwarded " by mail to the address of the Colonial Secretary or officer in charge " of the station.

"A complete schedule, to be varied from time to time as occasion " required, should be prepared of seeds and plants available for distri- " bution at the Central Establishment, and the cost at which they could " be delivered in the several islands. This schedule might appear as " a permanent feature in the Bulletin.

"It is important that applications for seeds and plants in connexion " with any island be received at Jamaica from some recognised person, " such as the Colonial Secretary or officer in charge of the station. " The Central Establishment would thus correspond with only one " person in each island, and that person would forward requisitions " and make payments for everything received from the Central " Establishment.

"The control of each station would be entirely in the hands of the " local government. The connexion with the Central Establishment " would be confined to dealing with applications for information on " local industries, for seeds, plants, or other purposes of a purely " consultative character.

"When communicating the adoption of the scheme to the other " islands, the Government of Jamaica will no doubt exactly define the " lines on which it is to be worked. The contribution of 20*l.* per " annum agreed to be paid by each of the local Governments to " Jamaica might be defined as intended to provide extra clerical " assistance at the head office and to cover cost of printing the " occasional bulletin, and other matters specially relating to the " stations.

"For seeds and plants required either by the stations or by private " individuals applying through the stations, payment should be made " in accordance with a general system, particulars of which would be " entered on the schedule above mentioned; and the amounts due " should be remitted to Jamaica at the time of order. Where this is " not possible it should be understood that expenses incurred at " Jamaica in behalf and at the request of any officer representing a " botanical station are chargeable to that station, irrespective of the

" fact whether they are ultimately intended for a private individual or " for the station.

" It might be useful to state clearly at the outset that the Central " Establishment has fully discharged its duty and obligations by placing " plants in good order on board the steamers at Kingston. No question " of liability should arise as regards plants damaged or lost in transit. " The stations must necessarily bear all risks of this character. They " should therefore interest themselves to secure careful treatment for " the plants by officers of the Royal Mail Company, and make the best " arrangements they can with the directors as regards transhipments, " freight charges, &c."

From the details given above, it will be observed that the scheme of botanical stations for the West Indies is one which seeks to meet the special circumstances under which they are now placed, and to do so in the most flexible and economical manner, and it is evident that by the adoption of such a scheme, which practically amounts to a botanical federation for purely economic purposes, these islands will be enabled to act much more thoroughly and economically as a whole than if each one depended entirely upon its own resources. The recent appointment of Mr. William Fawcett, B. Sc., F.L.S., a highly qualified botanist, to the post of director of the Botanical Department at Jamaica appears to offer every hope of success to the scheme. It is also anticipated that while granting valuable aid to the smaller islands, Jamaica as a centre will herself derive, both directly and indirectly, considerable benefit from such vigorous and systematic working as would naturally arise in her own area as well as from a larger interchange of plants and seeds with the neighbouring islands.

Considerable interest is being taken at Kew in this attempt to group scattered colonies, aud place them in a position to help each other in the development of local industries. The discussion of this scheme has already suggested the possibility of forming botanical stations in the several West African Settlements which are making an effort to turn to good account their natural productions. These have not hitherto been so largely utilised as they might be. The efforts made for so many years to assist Colonial industries by Kew has naturally thrown upon this establishment a large share in solving the botanico-economic questions which have affected the Colonies during the last 50 years. As a natural process of growth, it is only reasonable to expect that well-marked groups of Colonies should combine as regards questions of scientific and industrial interest, and that Kew should deal directly only with the recognised centre, from which would be distributed such special information and such collections of seeds and plants as are specially suited to local circumstances, and which could from time to time be reinforced from Kew. How far schemes of this kind can be carried out remains to be seen. At present there are good grounds for believing that the scheme will soon be on its trial in the West Indies, and the experience gained there will greatly assist in laying down the details of a further scheme that may prove of great value to the West African Settlements.

D. M.

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ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 7.] JULY. [1887.

XII.—ANNATTO.

(*Bixa Orellana*, L.)

From the seeds of *Bixa Orellana* is obtained a colouring substance which is known under various names. It is called Annatto, Arnatto, or Annotto in Jamacia ; in the French islands it is known as Roucou, Urucu, Rocour ; while on the Spanish Main the Indians call it Achiotl. This colouring substance has long been known and used for various purposes. It is, however, liable to so many fluctuations, and the prices generally are so low, that it has never received serious attention in British Colonies, and hence few, if any, plantations have been exclusively devoted in such colonies to the Annatto plant. The Annatto of commerce is practically, therefore, a forest product obtained from wild or semi-wild plants, and the supply has only kept pace with the demand. Of late years a slight revival has taken place in the use of Annatto, especially in America, and inquiries have in consequence been made for information as regards culture and preparation, which it is proposed to supply as briefly as possible in the following notes.

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1887.

Price Twopence.

The Annatto plant is a native of tropical America, but is now widely distributed throughout most tropical countries, where it is often found in a naturalized state, and growing freely in waste places and around native villages. It seldom attains a greater height than 8 to 12 feet, but is of stout bushy habit, and well furnished with bright heart-shaped pointed leaves. These are about 4 inches long and 2 broad, with rather a long petiole, and dotted. The showy flowers are produced in loose panicles at the ends of the branches, with five petals of a rosy and sometimes of a white colour. The stamens are very numerous, yellow, tipped with purple. The fruit consists of a dry ovate or mitre-shaped capsule covered with soft spinules, brown or green when ripe, splitting into two valves, on the inside of which are attached numerous (30 to 40) seeds. These seeds are about the size and shape of grape seeds, and covered with a waxy substance (the testa), which readily stains the fingers a red colour. This waxy substance covering the seeds yields the Annotto of commerce, and gives the plant its chief industrial value.

Annotto plants are readily raised from seed, and are of a hardy character. They prefer cool, moist situations, such as the banks of streams, and luxuriate in shaded places in and around dwellings. They are, however, readily established on comparatively poor soils, and although the growth under such circumstances is necessarily less robust, the yield in seeds is fairly large. If a plantation of Annatto is proposed to be established, plants may first be raised in seed beds in nurseries, and transplanted during the rainy season when about 6 or 8 inches high. The distance apart of permanent plants may vary from 10 to 15 or 20 feet, according to the character of the soil and the nature of any subsidiary cultivation that may be carried on. In many cases seeds may be sown at once in the places where the permanent plants are desired, and of the seedlings grown, the strongest only is ultimately retained. As cattle, horses, and goats do not eat the leaves of Annatto, planters in the West Indies often utilize hilly pasture lands by planting Annatto upon them. In this way very little expense is incurred for maintenance; and should the price of the produce prove of an unremunerative character, no steps are taken to gather the crop.

The range of cultivation for Annatto is a wide one. In the West Indies it grows readily from sea-level up to an altitude of 2,000 feet. In Ceylon it is known to grow up to 3,000 feet, but it is particularly flourishing in the lowlands. It appears to be well adapted for moist warm situations, with a mean annual temperature of 75° to 80° Fah. It requires an abundant rainfall, and hence is not suitable for arid situations, or those subject to prolonged droughts. Under favourable circumstances Annotto plants begin to yield seed in about two years, and remain fruitful for a long period.

The plant is supposed to be wild at Jamaica and St. Lucia, in the British West India Islands, and in the former island it has been extended by partial cultivation. The export of Annatto seeds from Jamaica in 1886 consisted of 369,284 pounds, of the value of 7,693*l*. At Guadaloupe, one of the principal French islands, Roucou, as it is there called, forms an important article of export, and the returns show the existence of 48 Roucou plantations, employing 1,044 labourers. The export in 1883 consisted of 700,500 kilos of prepared Roucou. [Flag Annatto.]

As regards British Guiana, the Superintendent of the Botanic Garden, writing in 1881, remarks as follows:—"Though the Annatto plant is a "native of British Guiana, and abounds on the banks of some of the "rivers, it does not appear to be cultivated at all, nor is the fruit of the

" wild plant turned to any commercial account. All the Annatto that is " exported from British Guiana is first imported, and the source from " which it comes, so far as I have been able to gather, is French Guiana. " A portion may occasionally come from Surinam." As may naturally be expected, a plant of so hardy a character, and the seed of which is so easily carried from place to place, has long been established throughout the Tropics. At Ceylon the plant is supposed to have been introduced by the Dutch, and so long ago as 1829 it was used as a dye plant by basket makers at Kalutara.

In the Report of the Director of the Botanic Gardens, Ceylon, for 1881, it is mentioned, " Several gentlemen have made inquiries as to the " mode in which Annatto is prepared for the market; and, as I could " find no very definite published account, I applied to the authorities at " the Royal Gardens, Kew, for information, and have received several " communications from them, the most important being from Mr. " Vilmorin's report on 'Produits Agricoles non Alimentaires' (Paris " Exhibition, 'Rapports du Jury International'). The following is a " summary :—*Bixa Orellana* is native to Tropical America, but fairly " naturalized in other hot countries, as in India and Ceylon. Annatto " (Roucou is the French name), however, is prepared almost wholly in " the French colonies, chiefly Cayenne (French Guiana) and Guada- " loupe (which each produce about 400—500,000 kilos), but lately " taken up also in Réunion and the Indian Possessions of France. " The Guadaloupe samples were the best at the Paris Exhibition."

In India the two forms of the species, one with pink flowers and brown capsule and the other with white flowers and greenish capsule, are well represented. Dr. Buchanan, writing in 1833, mentions the Annatto plant as follows: "The *Bixa*, an American plant, is now " rapidly spreading over Bengal, the inhabitants having found it a " useful yellow dye, which they employ to give their cloths a temporary " colour in the *Dolyatra*, or festival of Krishna. With this also they " colour the water, which, on the same occasion, they throw at each " other with squirts. For these purposes it is well qualified, as the " colour easily washes out, and the infusion has a pleasant smell. By " them it is called *Lotkan*, and they say that before it grew commonly " in the country, the dry fruit was brought from Patna. Probably " some other fruit was then brought, and its use has been superseded " by that of the *Bixa*, to which the natives have given the old name, " as there can be no doubt of its being an American plant, and its fruit " could scarcely have been brought here from the West Indies. In " many parts it is called European Turmeric."

As regards the preparation of Annatto it would appear that various methods are used, with the result that an article is produced with a wide range of merit and a corresponding variation in market value. At the request of this establishment, inquiry was made respecting the method adopted in French Guiana, and the Superintendent of the Botanic Gardens at British Guiana obtained the following from the French Consul at that place. The manufacture of Roucou is as follows:

" Pick the small red seeds from the husk, put them in fresh and clear " water to soak for not less than two days, then pass them through a " mill or crusher. When crushed let them remain 24 hours in fresh " water; after this pass them through a sieve; the residue is again " passed through the mill until nothing remains of the seeds.

" The produce of the seeds so prepared is put in water until it has " precipitated; the surface water is then made to run out. After the " surface water has become perfectly clear, the paste is boiled during

" four or five hours time. After this process has been gone through, " the paste is placed in cases with curing holes, with a weight placed " on it, and a cloth at the bottom to prevent the finely crushed powder " from passing through. When the above process has been gone " through, the paste should be in a fit state for shipment. It is then " packed in layers, with plantain leaves between each layer to retain " the necessary amount of moisture and to check acidity."

A method for preparing Annatto, at one time prevalent in the West India Islands, is well described by Dr. Macfadyen in the *Flora of Jamaica*, p. 42, in the following words:—

"It is from the pulp which covers the seeds of this tree that the " substance known by the names of *Arnotta* or *Annotta* in England, and " *Roucou* in France, is procured. It is collected by pouring boiling " water on the seeds in any convenient vessel; after stirring the whole, " the water, with the farina suspended in it, is poured off; and this is " repeated till the naked seeds are left. The water, after allowing it to " stand for some time, is then to be poured off clear, leaving the *Arnotta* " which has settled at the bottom. The addition of an acid is said to " hasten the process. The sediment is afterwards to be placed in " shallow vessels and dried by evaporation in the shade. When it has " acquired a proper consistence, it is to be made into cakes or balls; " after which it is to be thoroughly dried till hard, when it is in a fit " state to be sent to market."

To this Dr. Macfadyen adds some general remarks as regards Annatto and its local uses in the West Indies, which, as they occur in a book now comparatively scarce, may be usefully included in these notes:—

"*Annatto* is of a resinous nature, and dissolves more completely in " alcohol than in water. When prepared for market it is moderately " hard, of a brown colour externally, and dull red within. It is " occasionally imported in cakes of two or three pounds weight, of the " consistence of paste, wrapped up in large flag [banana] leaves, and " packed in casks. The roll *Annatto* is much harder, and of a very supe- " rior quality, containing a larger proportion of the colouring matter. It " was formerly employed in dyeing silk, to produce the colour called " *Aurora*. As the addition of an alkali increases its solubility, it is the " practice, when used in dyeing, to mix it with at least its own weight " of potash. It is now, however, but seldom employed as a dye in " Great Britain. The Indians mix it with oil, or with lime-juice and a " gum, to make the crimson paint with which they anoint their bodies, " not so much for the purpose of ornament as to protect them from the " attacks of insects. It is said to be esteemed by painters as a colour. " In Gloucestershire it is employed under the name of *cheese colouring*, " to give a yellowish-orange tint to cheese, and in Holland to butter. " It has never had any great character as a medicine. It is a gentle " purgative, and a light stomachic; it has been employed in dysentery, " and as an antidote for the bitter Cassada. The Spaniards use it in " their chocolate and soups to heighten the flavour and to give a rich " agreeable colour. In Jamaica, a liquid preparation is usually kept " for culinary purposes, made by boiling the pulp, diffused in water, " with sugar and salt to the consistence of cream, which, if put into " well-corked bottles, will keep for several years."

A method recommended by the Director of the Botanic Gardens at Ceylon for preparing Annatto, and which, no doubt, has been followed in the manufacture of some fine samples of Annatto lately exported from that island, is as follows:—"The best method of preparation " appears to be (there are some discrepancies in different accounts) the

" following :—The seeds, with their pulpy envelopes, are pounded in a " wooden mortar, and, after adding hot water, the mixture is left in the " mortar for several days, after which it is passed through a sieve. " The liquid is then left to ferment for eight days, when the water is " decanted off, and the deposited pulp left to become concentrated by " evaporation in the shade. When it has acquired the consistency of " firm putty, it is made up into cakes of 1½—2 kilos weight. These " are packed with plantain leaves, and have a lively orange-yellow " colour ; the value is about 4 fr. the kilo. In Cayenne it would " appear that the pulp is sometimes boiled for four or five hours, and " afterwards put under weights to squeeze out the water. It is also " sometimes made into rolls instead of cakes, in which state it appears " to fetch an inferior price."

* * * * * *

" The trade in Annatto is a limited one. It is used as a dye " occasionally, but its principal employment is for colouring cheese and " butter."

In *Tropical Agriculture*, p. 389, it is stated that Annatto "owes its " value to the colouring matter bixin and orellin, which constitute " about 20 per cent. of good dry Annatto. Fresh Annatto contains " more than half its weight of water. It was formerly employed in " dyeing wool and silks, but its colour, though beautiful at first, soon " fades, and hence it has been abandoned for more permanent dyes.

" Annatto is principally consumed by painters and dyers, but it is also " used to colour cheese with a pale yellow or flesh colour. The Dutch " use it for heightening the colour of their butter, and it is employed " for the same purpose in some American and English dairies."

As regards the European process of extracting and preparing Annatto, Ure writes :—

" Leblond proposed simply to wash the seeds of the *Bixa* till they " are entirely deprived of their colour, which lies wholly on their " surface ; to precipitate the colour by means of vinegar or lemon- " juice, and to boil it up in the ordinary manner, or to drain it in bags " as is practised with indigo. The experiments which Vauquelin made " on the seeds of the *Bixa* imported by Leblond confirmed the efficacy " of the process which he proposed ; and the dyers ascertained that the " Annatto obtained in this manner was worth at least four times more " than that of commerce ; that, moreover, it was more easily employed, " that it required less solvent, that it gives less trouble in the copper, " and furnishes a purer colour.

" Annatto dissolves better and more readily in alcohol than in water " when it is introduced into the yellow varnishes for communicating " an orange tint."

The methods described above for the preparation of Annatto are not intended to serve as standards of what the preparation of this substance should be in tropical countries. They are given merely as descriptions of methods hitherto followed, and which produce the "roll," "flag," and "cake" Annatto as usually seen in European markets. If a large demand arose for Annatto, improved methods of preparation would doubtless be soon adopted.

Mr. J. J. Bowrey, F.C.S., Government Analytical Chemist at Jamaica, has prepared powdered Annatto of great strength and brilliancy by treating fresh ripe seed locally, and he has obtained one ounce of colouring matter from one pound of freshly cured seeds. An exhibit, consisting of the cured Annatto seeds, of the colouring matter obtained from them, as well as of flannel dyed with the extract and with the

ordinary Annatto of commerce, was shown at the Jamaica Court at the New Orleans Exhibition in 1885, and attracted considerable attention. At the late Colonial and Indian Exhibition there were numerous samples of Annatto seeds shown from Jamaica. Mr. F. B. Sturridge also exhibited a series of preparations which were described as follows :—
" 297. Annatto seeds in natural state. 298. Annatto and lard free
" from foreign substances slightly salted. 299. Annatto washings after
" principal colouring matter has been extracted, showing colouring
" portion of seeds, which is soluble in water. 300. Annatto seed and
" olive oil. 301. Annatto and petroleum, showing amalgamation of
" colouring matter with any oleaginous substance. 303, 304, 305.
" Colours from Annatto precipitate and Annatto paints."

In a letter received at Kew in 1881, from a firm dealing largely in Annatto, it is stated that "the best flag Annatto is decidedly from
" Cayenne (French Guiana), and it used to come by way of the United
" States, but it comes now direct from the French ports. The seeds
" are carefully washed in the preparation it undergoes at Cayenne, the
" clear fluid being drawn off, and the residuum, with which oil is some-
" times mixed, is placed in shallow vessels and gradually dried in the
" shade. Others use an evaporating pan for this purpose. Annatto is
" a limited trade with us. There is no scope for making a large fortune
" in it. One pound of good Annatto will colour one ton of cheese.
" Guadaloupe Annatto is of a fine colour, but is too acid for our
" purpose."

In a recent English trade circular it is stated :—"The dubious mode
" of curing Annatto, so long pursued in the French colonies, from
" whence the supplies have been chiefly derived, will, it is thought, ere
" long be abandoned. It has been proved to be as unnecessary as
" objectionable."

* * * * *

"Formerly the only extracts or pastes of Annatto were the descriptions
" known as cake and roll.
"Then followed the liquid extract, which largely superseded, but by
" no means entirely, the other two, which have still an important sale
" in various districts. The liquid extract, while it keeps its place for
" cheese tinting, has yielded in turn to a non-chemical preparation of
" the pure seeds in refined vegetable oils, selected for sweetness and
" non-tendency to rancidity or congelation."

Messrs. S. G. Clements and Co., of Bristol, addressed the following letter to this establishment on the subject of Annatto, dated 14th June, 1887 :—

"Will you permit us to make inquiry bearing on the production of
" Annatto, with the seed export of which you would be well acquainted
" while in the West Indies.
"If you find time we should esteem your consideration of the remarks
" the writer has made in the trade circular enclosed.
"You will see that there is the feeling that more could be done in our
" own territories with advantage if the mode of preparing were closely
" studied.
"The value of Annatto *seed* at market is to-day unusually low, good
" quality having been done at $2\frac{1}{2}d.$ lately, so that growers cannot be doing
" well with it. Now, in Ceylon, an extraordinarily fine bright *paste*
" is made, and we think we purchased the first lots of it brought over,
" through London brokers, at a much higher price than any paste or
" flag Annatto then offered in London or Liverpool. It was followed
" by other lots not quite up to the first grade, and the disparity in

" values between 'Cayenne' best and this 'Ceylon' was too great to " induce us to go on buying, except in small lots occasionally for mixing " and improving. On lately inquiring the value, our brokers tell us " the bulk of it is going to the United States of America, and there " fetching 3*s.* 6*d.* per lb. !

" Best 'Portal' Cayenne is not worth 1*s.* to-day, so that we are " open to doubt the statement to *that extent;* but it all leads to this, " that if our Jamaican friends would prepare a few cwts. of *paste* on " the Ceylon system they would relieve the depressed condition of " their Annatto market. No doubt this method of the Cingalese must " be ascertained, but that difficulty might be bridged over by inquiries " instituted by those who are known to ask for a public purpose rather " than by interested dealers.

" If, therefore, you could add this to the many far more valuable " branches of investigation, which, no doubt, 'run' your time already " too closely, we feel sure you will excuse the mention of it.

" Any facts as to Annatto preparations, &c. we should be glad to " give so far as they are known on this side only."

In reply to this letter, it was mentioned that the tendency in the West Indies at the present time is not to manufacture Annatto, but to export the seeds in a cured state. Owing to the fact that prepared Annatto is subject to a heavy duty in America, while the cured seeds, as a raw product, are admitted free of duty, growers have found it more advantageous to ship seeds than prepare the Annatto. As stated above, Annatto seeds were exported during the year 1886, chiefly to America, from Jamaica to the extent of 369,284 pounds, of the value of 7,693*l.* It is evident that either in the preparation of butterine, and analogous substances, or in some special process of dyeing, Annatto has been found of service in the United States, and an impetus has been given to the cultivation, which has rescued it from the stagnation in which it had remained for more than 20 years. It is only right, however, to point out that Annatto it still a precarious and somewhat uncertain article in commerce, and the demand is distinctly limited; it may, however, receive attention as a subsidiary subject, and to meet the demand in America it is evidently better to gather the seeds, and, after carefully drying them in the sun until quite "cured," to ship them in ordinary barrels as a raw product. Annatto seeds at Jamaica usually sell locally for 6*d.* to 10*d.* per pound. Preparations of Annatto are sold in London, according to Messrs. Burgoyne, Burbidges, Cyriax, and Farries Prices Current, June 1887, as follows:—" Spanish flag, re-rolled, No. 1, 3*s.* 3*d.* per pound; " Cake (Fulwood), 3*s.* 6*d.* per pound; extra super, 3*s.* 9*d.* per " pound."

A further letter, which has been received from Messrs. S. G. Clements & Co., dated 17th June 1887, contains some useful hints, which may be of service in the colonies:—

" We are much obliged by your reply on Annatto production.

" It should not be overlooked that seed though gradually taking the " place of paste and flag (*i.e.* wrapped in flag). Annatto is too low to " pay, being procurable in quantity in England at less than 3*d.* per lb. " Indeed 8*d.* was a very high price for it several years ago. We do " use the seed continuously and the paste and flag also.

" The latter from Guadaloupe is *now* about the value of the seed, or " under 3*d.*, but the Cayenne best brands are more than thrice that in " first hand—more than 9*d.* per lb.

" There is when certain colours are prevalent, a large demand for " flag Annatto or cotton and for silk dyeing, and we must expect

" Annatto to rise in value. We may state that a year or two ago the " Guadaloupe even rose to 10*d.* and 11*d.* per lb., or more, for a short " time.

" It shows that addiction to one branch of production only debars " from constantly taking the market, while by a versatility of treatment " produce may always fetch the highest value for that form of it most " in demand at the time.

" Our colonial friends might reasonably vie with the French West " Indians in sending paste and flag Annatto to European markets, or if " they would observingly 'distil out,' as it were, a better method, " approaching, we think, rather the Sinhalese than the Cayenne or the " Guadaloupe, drive the two latter from these markets.

" There is another form of Annatto, viz. 'Roll' from Brazil. It is " worth in its best state of cure 1*s.* 9*d.* per lb. to-day, and even more " is asked by the brokers. This sort has very little staining power, " but is pleasanter smelling, and is put up in rush baskets of about " 40 lbs. each, apparently as much as a man could trot with on his " shoulder. Why this kind cannot be made by our colonists we are at " a loss to know. Is the Brazil Rocou or Bixa another species ? [No.]

" We endeavoured to persuade Demerara shippers here in Bristol to " get Annatto preparing taken up in British Guiana. Inquiries were " made, but it was replied that, though the trees were abundant, the " industry was not large enough, side by side with sugar and rum, to " engage their attention. Perhaps, though, other of our West Indian " friends might profitably give some time to this as one of the smaller " (but easy) industries, which, combined, might 'pare out' as profitably " as the bulkier ones now slipping from their grasp. And the wish to " foster effort after such substitutes must be our excuse for diverting " your attention thus far."

Messrs. Fulwood and Bland, one of the oldest manufacturers of Annatto in this country, mention that it would be of service to growers of Annatto to learn that seed should only be shipped to London where appliances for preparing Annatto locally entirely fail. It is, in their opinion, better to prepare good high class Annatto in the Colonies than ship seed. The latter can only fetch about $3\frac{3}{4}d.$ to 6*d.* per pound for good sound seed, while inferior or mouldy consignments are dear at any price. The price of Flag Annatto varies from 5*d.* to 1*s.* 8*d.* per pound; but if really good Annatto, prepared under European supervision, became established in London, it would supersede most of the present French Annattos, which are, as a rule, of inferior quality.

In the Kew Museum of Economic Botany there is a very interesting series of Annatto from nearly every portion of the Tropics. These consist of cake Annatto from Madras, presented by Dr. Cleghorn; Fullwood's Annatto, one of the best preparations in the English market, from A. S. Hill and Son; Annatto from Jamaica, by H. Battcock; Annatto from British Guiana, International Exhibition, 1862; Annatto mixed with crab oil from British Guiana, International Exhibition, 1862. "Faroah" paint, used by Indians, made from seeds of *Bixa Orellana*, British Guiana, E. F. im Thurn; sample of flag Annatto of commerce; fruit and seeds of Annatto, Bombay, from India Museum; fruits of Annatto from Samoa, Rev. J. Powell; from Venezuela, International Exhibition, 1862; from the Amazon, Dr. Traill; seeds of Annatto from Madras, Calcutta, and British Burma; "Achota" seeds from Peru, Paris Exhibition, 1878; and Annatto seeds as usually exported from Jamaica, Colonial and Indian Exhibition, 1886.

XIII.—BOTANICAL STATIONS IN THE WEST INDIES.

In the *Bulletin*, No. 6, June 1887, there was discussed with some fulness a scheme which has been devised for extending the benefits of Botanical Gardens to the smaller islands in the West Indies. Since the issue of that *Bulletin* further information has been received, which is now given in order to complete the historical sequence. It will be noticed that the Government of Jamaica is prepared to adopt the scheme from the 1st August next.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street, 3rd June 1887.

SIR,

I AM directed by the Secretary of State for the Colonies to transmit to you, for your information, with reference to your letter of the 19th of February last and previous correspondence, the accompanying copy of a Despatch from the Governor of Jamaica, relating to the proposed establishment of Botanical Stations in the West Indies.

I am, &c.

The Director of the Royal Gardens, Kew.

ROBERT G. W. HERBERT.

Enclosure No. 1.

Sir HENRY NORMAN to Sir HENRY HOLLAND.

Jamaica, No. 15.

King's House, 10th May 1887.

SIR,

WITH reference to the correspondence, which I had the honour to hold with you while recently in England, on the subject of the scheme for the establishment of a system of Botanical Stations in the West Indies, having its centre at Jamaica, and with reference to an interview I had with Mr. Thiselton Dyer and Mr. Morris at Kew last March, I have the honour to forward, for your information, copy of a letter which I have addressed to the Governor of Barbados, and to the Governors of the other Colonies, mutatis mutandis, interested in the matter, after receiving the remarks of Mr. Fawcett, Director of Public Gardens and Plantations, on the memorandum which Mr. Morris submitted to you.

I have, &c.

(Signed) H. W. NORMAN,
Governor.

The Right Hon. Sir Henry Holland, Bart., G.C.M.G., M.P.,
&c. &c. &c.

Enclosure No. 2.

The GOVERNOR of JAMAICA to the GOVERNORS of BARBADOS, the LEEWARD ISLANDS, the WINDWARD ISLANDS, and BRITISH HONDURAS respectively.

No. 3421.

King's House, Jamaica,
9th May 1887.

SIR,

I HAVE the honour to inform you that the Secretary of State for the Colonies communicated to me a copy of a Despatch which Lord Derby had addressed to you, in common with the Governors of other West Indian Islands, transmitting copies of a letter from Mr. Morris, the Director of Public Gardens and Plantations in Jamaica, now of the Royal Gardens, Kew, respecting a proposal made in 1884 that Botanical Stations should be established in some West India Islands in connexion with the Botanical Department in Jamaica, and recommending the adoption of the scheme in those colonies.

2. I would further inform you that I am advised that the colonies named in the margin are prepared to join with the colony under your Excellency's administration in establishing Botanical Stations, and to provide twenty pounds (20*l.*) a year each towards the expenses of the Jamaica Botanical Establishment in carrying out the scheme.

3. I have recently received a copy of a subsequent memorandum from Mr. Morris to the Colonial Office, setting forth some of the working details of the scheme, of which I beg leave to enclose a copy for your Excellency's information, inviting your remarks upon it.

4. I desire to inform you that this colony is prepared to adopt the proposed scheme from the 1st August next, or from any subsequent date, and I would suggest that the local superintendent of the Botanical Department (if there is one) should communicate on the subject direct with Mr. Fawcett, the Director of Public Gardens and Plantations in this island.

5. As regards the carriage of plants, I would suggest that application be made to the Royal Mail Steam Packet Company for the free carriage, or the carriage at low rates, of plants.

I have, &c.
(Signed) H. W. NORMAN,
Governor.

DOMINICA.—Reference was made in *Bulletin*, No. 6, pp. 9 and 10, to the collection of economic plants already made at St. Aroment, Dominica, by the late Dr. Imray and Dr. H. A. Alford Nicholls. Many of these plants have been sent out from Kew in exchange for Dominica plants, kindly contributed at the private expense of the two gentlemen above mentioned. In connexion with the establishment of a Botanical Station or a Botanical Garden, it may be useful to place on record a list of the introduced economic plants already growing at Dominica, which has been kindly prepared by Dr. Nicholls:—

Abelmoschus moschatus - -	Musk Mallow - -	India.
Adansonia digitata - -	Baobab, or Monkey Tamarin	Africa.
Aleurites moluccana - -	Candle-nut - -	Pacific Islds.
Allamanda Aubletii - -		Guiana.
Amomum Melegueta - -	Grains of Paradise -	Trop. Africa.
Areca Catechu - -	Betel Nut - -	E. Indies.

Artocarpus integrifolia	Jack Fruit	Polynesia.
„ Lakoocha	Lakoocha	E. Indies.
Averrhoa Carambola	Caramba	„
„ Bilimbi	Blimbing	„
Baloghia lucida	Blood Wood	Norfolk Isld.
Bambusa gigantea	Giant Bambu	E. Indies.
„ stricta	Male Bambu	„
Blighia sapida	Akee	Africa.
Brownea arbiza		Trop. America.
Camellia theifera	Tea	Assam.
Caryophyllus aromaticus	Clove	Moluccas.
Cassia Fistula	Purging Cassia	E. Indies.
„ grandis	Horse Cassia	Brazil.
Chloroxylon Swietenia	Satin Wood	India.
Chrysophyllum Cainito	Star Apple	W. Indies.
„ oliviforme	Star Plum	„
Cinnamomum Cassia	Cassia	China.
„ zeylanica	Cinnamon	Ceylon.
Citrus Limonum	Lemon	Cultivated.
Citrus medica	Citron	„
Cæsalpinia coriaria	Divi-divi	S. America.
Coffea liberica	Siberian Coffee	Africa.
Cola acuminata	Kola Nut	W. Trop. Africa.
Cookia punctata	Wampee	China.
Corypha umbraculifera	Talipat	Ceylon.
Dipterix odorata	Tonquin Bean	Guiana.
Durio zibethinus	Durian	Ind. Arch.
Elettaria Cardamomum	Cardamoms	India.
Elaeis guineensis	Oil Palm	W. Trop. Africa.
Epipremnum mirabile	Tonga	Polynesia.
Eriobotrya japonica	Loquat	China.
Erythrina umbrosa	Immortelle	Trop. America.
Erythroxylon Coca	Coca	Peru.
Ficus elastica	India-rubber	India.
„ Cooperi		Queensland.
„ macrophylla		Australia.
Furcræa cubensis var. inermis	Silk Grass	W. Indies.
Galactodendron utile	Cow Tree	Venezuela.
Garcinia Morella	Camboge	Ceylon.
„ Mangostana	Mangosteen	Ind. Arch.
Grias cauliflora	Anchovy Pear	Jamaica.
Guaiacum officinale	Lignum vitæ	W. Indies.
Hemidesmus indicus	Indian Sarsaparilla	E. Indies.
Hevea brasiliensis	Para Rubber	Brazil.
Jatropha podagrica	-	Central America.
Jambosa malaccensis	Malay Apple	E. Indies.
Kopsia fruticosa	-	„
Landolphia florida	African Rubber	Trop. Africa.
„ Kirkii	„ „	E. Trop. Africa.
Lawsonia inermis	"Mignonette" Tree	E. Indies.
Malpighia glabra	Barbados Cherry	W. Indies.
Manihot Glaziovi	Ceara Rubber	Brazil.
Mangifera indica	Mango	E. Indies.
Maranta arundinacea	Arrowroot	S. America.
Melicocca bijuga	Genip Tree	W. Indies.
Michelia Champaca	Chumpaka	E. Indies.
Mimusops Elengi	-	Ceylon.
Monstera deliciosa	-	Mexico.
Moringa aptera	Ben Tree	N.E. Africa.
Myristica fragrans	Nutmeg	Ind. Arch.
Myroxylon toluifera	Balsam Tree	S. America.
Musa superba	Flowering Plantain	
Napoleona imperialis	Napoleona	W. Africa.
Nephelium Litchi	Litchi	China.
Phœnix dactylifera	Date Palm	N. Africa.
Phyllanthus distichus	Nelli	E. Indies.
Phytelephas macrocarpa	Ivory Nut	S. America.

Pithecolobium (Inga) Saman -	Guango - -	S. America.
Pimenta vulgaris - -	Allspice - - -	W. Indies.
Piper methysticum - -	Kava-Kava - -	Pacific Isds.
„ nigrum - - -	Black Pepper - -	E. Indies.
Piscidia Erythrina - - -	Jamaica Dogwood -	W. Indies.
Psidium cattleianum - -	Purple Guava - -	„
Ravenala madagascarensis -	Travellers Palm -	Ma agascar.
Rubus rosæfolius - -	Tropical "Raspberry"	E. Indies.
Sansevieria guineensis - -	African Hemp - -	Africa.
Spondias dulcis - - -	Sweet Plum - -	Society Islds.
„ tuberosa - -	Hog Plum - -	Trop. America.
Stifftia chrysantha - -	- - - -	Brazil.
Strelitzia reginæ - - -	- - - -	S. Africa.
Strychnos nux-vomica - -	Nux-Vomica - -	Eastern Tropics.
Swietenia Mahagoni - -	Mahogany - -	W. Indies.
Tamarindus indica - -	Tamarind - - -	E. Indies.
Tanghinia venenifera - -	Tanghin - -	Madagascar.
Terminalia Catappa - -	Java Almond - -	Tropics.
Thrinax argentea - - -	Silver Thatch - -	W. Indies.
Treculia africana - -	African Bread-fruit	W. Africa.
Vanilla planifolia - - -	Vanilla - - -	Trop. America.
Vangueria edulis - -	Voa-Vanga - -	Madagascar.
Yucca aloifolia - - -	"Dagger" plant -	America.
„ gloriosa - -	Adam's needle - -	„
Zingiber officinale - - -	Ginger - - -	Tropics.
Zizyphus rugosus - -	Jujube - - -	Old World Tropics.

Note.—Besides the plants enumerated above, there are established at St. Aroment about 30 species of palms from various parts of the world, which are doing well.

Grenada.—The new Botanic Garden at Grenada has already been noticed. It is situated a short distance from the town of St. George, on the road leading to Clarke's Court. The locality is described by His Excellency the Governor-in-Chief as a "good site, well watered, acces-" sible, and apparently in every way suitable for the purpose." A grant of 300*l.* was made by the Legislative Council in October 1885, and a further sum of 1,000*l.* was provided in July 1886 to establish and lay out a Botanic Garden and erect a house for the Curator. The objects of the Garden are stated as follows: To introduce and distribute plants of great economic value, to supply practical hints respecting new and promising industries, and to develop and improve existing minor industries. In the first Report, lately issued, it is stated that "two " Wardian cases containing very valuable plants were received from " Kew in July last, and 108 packets of various economic seeds have " also been received from the same source."

The initiative as regards a Botanic Garden at Grenada is due to His Excellency W. J. Sendall, C.M.G., and to him and to Captain Maling and members of the Garden Committee the success of the efforts so far made is due.

A letter has lately been addressed to Kew by Mr. W. R. Elliott, the Curator, which, as it gives the most recent account of this Garden, may prove of interest.

Mr. W. R. Elliott to Royal Gardens, Kew.

Botanic Garden, Grenada,
11th June 1887.

Sir,

I have to acknowledge the receipt of your letter *in re* the seed of *Buchanania latifolia*, received from you in September last, and to

inform you that I have succeeded in raising a large number of plants. I have distributed numbers throughout the island, all of which are growing very satisfactorily.

I am happy to be able to report good progress with our Botanic Garden here. The laying out is completed, and the Gardens are to be thrown open to the public this month. The water difficulty has been only partly surmounted, and during the late dry season considerable difficulty was experienced in keeping things alive. The wet season has, however, now commenced, and there is every sign of a repetition of last year's; and it is to be hoped that before the dry season of next year returns we shall have a good water supply.

The plants received from Kew in the two Wardian cases last year are thriving remarkably well; one plant of *Manihot Glaziovii* is 20 ft. high, and flowering profusely. I intend returning the cases in the course of two or three mails; one I am anxious to fill with a small palm I found growing on the summit of *Irdous Camp*, our second mountain in height, about 2,700 ft. This palm completely covers the entire summit of the hill, to the exclusion of every other tree; I believe it is *Hyospathe pubigera*. Unfortunately, I was unable to obtain good botanical specimens, but succeeded in getting numbers of small plants.

By the mail leaving here on 26th instant I am sending, for determination at Kew, a large parcel of specimens of ferns, &c. collected on this hill and elsewhere.

I have a fine plantation of tobacco, about one acre, raised from the Havana seed you sent me.

I am, Sir,
Yours very faithfully,
(Signed) W. R. Elliott.

D. Morris, Esq., M.A., F.L.S.,
Assistant Director,
Kew.

D. M.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 8.] AUGUST. [1887.

[*Introduction of certain West Indian Food-plants to the East Indies.*

In the following notes information is given respecting certain food-plants from the West Indies recently introduced to the East Indies, and which are now established in the latter. These are the Tree Tomato (*Cyphomandra betacea*), the Chocho (*Sechium edule*), the Arracacha (*Arracacia esculenta*), and the Cherimoyer (*Anona Cherimolia*).

The introduction of the Arracacha was first attempted, at the instance of the Government of India, in 1879, but, after many failures, was only successfully accomplished in 1883. The Chocho was introduced to Ceylon by means of a single plant, which survived the journey direct from Jamaica to Ceylon, in January 1885. The Tree Tomato and Cherimoyer were introduced by seeds, which travel well, and are more convenient for distribution than plants. In a few years, no doubt, all these plants will be widely distributed throughout the East, and they will be found useful additions to the vegetable diet of both Europeans and natives. Already the Chocho introduced to Ceylon as recently as 1885 is to be found in the local markets; and the Tree Tomato is mentioned "as a most valuable acquisition to Southern India."

All the four plants here mentioned are likely to thrive at Hill Stations in India and in all districts suitable for coffee and cinchona cultivation. They are sub-tropical rather than tropical in their requirements, and hence no doubt they will be found of service in South Africa, in certain parts of Australia, Northern New Zealand, and in hilly districts generally throughout our tropical possessions. The information here summarized will indicate their usefulness as food-plants and the sources both in the Old and New World from which future supplies of seeds and plants may conveniently be obtained.]

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1887.

Price Twopence.

XIII.—TREE TOMATO.

(*Cyphomandra betacea*, De Candolle.)

Although called a tomato, this plant, which is a native of the Andean regions of Tropical America, is a large free-growing shrub or small tree, often attaining a height of 8 to 12 feet. The fruit in form is more like that of the egg-plant or brinjal, but in colour and flavour it more nearly approaches the tomato. Like these two, however, it belongs to the natural order Solanaceae.

It appears as *Solanum betaceum* in Cavanilles, Ic. n. 599, tab. 524, which gives a fairly good figure of both the plant and the fruit. A large coloured plate of the leaves and flowers appears in the Botanist's Repository, tab. 511. In the *Revue Horticole*, 1880, p. 150, there is a coloured illustration of the plant with flowers and fruit, which is reproduced in the *Gardener's Chronicle*, Third Series, Vol. I. (1887), p. 383, with a description by Mr. D. Morris. Fuller notes are given by the same writer in *Gardener's Chronicle*, N.S., Vol. XXI. (April 19, 1884), p. 510. The illustration from the *Gardener's Chronicle*, by kind permission of Dr. Masters, F.R.S., we are able to give on the opposite page. The fruit in this instance is much too pointed and gives the appearance of not being fully ripe. A much better illustration of the fruit is given in *Revue Horticole* for 1881, p. 470, which is intended to represent two varieties obtained from seed of the plant figured in 1880.

The leaves are large (sometimes a foot long), broadly cordate, and softly pubescent, generally confined to the termination of the branches. The fragrant flowers appear as sub-axillary cymes of a pale fleshy colour, with bright yellow stamens, followed by an obconical or ovate fruit, which at first of a greenish or purplish tint gradually assumes a warm reddish colour as it approaches maturity. The bilocular fruit is of firm texture, about 2 to 2½ inches long, and about 2 inches in diameter. The pericarp is about ¼ inch in thickness, of a pale orange colour.

On the mainland of Central America it is known as the Tomato de la Paz, in Jamaica as the "Tree Tomato," and sometimes, on account of its supposed beneficial action on the liver, "Vegetable Mercury." Plants are easily raised from seed, and come into bearing in about two years. They are very prolific bearers, and the fruit is available during the winter months, November to March, when ordinary tomatoes are not so easily obtained.

If the fruit is allowed to fully ripen on the trees it may be eaten raw, and it has somewhat the flavour of gooseberry. If the skin is removed and the fruit (without the seeds) stewed with sugar, it resembles apricot, but with a slight sub-acid flavour, which is very refreshing.

Mr. Miers (Hook. Journ. Botany, 1845, p. 358) describes this plant under the name of *Pionandra betacea*, and mentions that "this is "doubtless the same fruit that I saw in the markets of Lima, where it is "commonly used for cooking in lieu of the ordinary tomato, the flavour "of which it resembles."

The Tree Tomato was introduced to Jamaica many years ago, and it is sparingly met with on old coffee plantations in the hills of St. Andrew and Manchester. It does not flourish in the plains. Its range of elevation in Jamaica is from 2,000 feet to 5,000 feet, with a range of temperature from 72° to 63° Fahr. It is found at Madeira and the Azores, and cultivated in the South of Europe. According to Dr. Masters, the fruit is occasionally seen in Covent Garden Market under the

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Tree Tomato.

erroneous name of "Grenadilla." Plants are grown at Kew in the Temperate House and also in the cool Economic House. They generally bear late in the autumn, and hence the fruit seldom ripens properly and is not in good order. Through the agency of the Botanical Department at Jamaica seed of this plant and information respecting it have been widely distributed throughout British Colonies, and it may now be considered fairly established in most of the regions of a sub-tropical character suited to its growth.

In the Report of the Director of the Botanical Gardens, Ceylon, for the year 1884 it is stated that the *Cyphomandra betacea* "is a close "ally of the ordinary Tomato, and a native of Peru and neighbouring "countries, but cultivated on the hills in many parts of South America "and the West Indies. Its fruit, which is red, and the size of a "pigeon's egg, may be employed in all ways like the tomato, and "resembles it in flavour. Seeds have been received from Jamaica, and "there are now many young plants at Hakgala."

In the Report for the year 1885, Dr. Trimen mentions that at Hakgala at 6,000 feet some of the Tree Tomato plants "are now 11 feet high, "and the fruits produced are very fine. They are egg-shaped, about 3 "inches long and 2 inches in diameter, and when fully ripe are of a "bright yellowish-red colour. They make excellent tarts, are very "good stewed, and are much relished by most people when quite ripe "and eaten raw, like gooseberries. The plant is very robust and easy "to grow here, and I believe it will thrive and be very profitable from "an elevation of 2,000 to 6,000 feet. Under favourable conditions "the plant remains in bearing for many (10 or more) years."

In the last Report to hand, that for the year 1886, it is stated that "the Tree Tomato has spread rapidly through the hill country. "This fruit keeps well after being gathered, and as it has a tough skin "and travels well it might be largely cultivated in the villages for sale "in the towns."

Large quantities of seeds were also sent from Jamaica to the Madras Agri-Horticultural Society for the purpose of establishing the plant in the Nilgiris and other hilly districts of Southern India. In a Report on the Shevaroy Hills for 1884, furnished to the Society by Deputy Surgeon-General Shortt, it is mentioned :—

"Through the kindness of the Society, I have received from time to "time a variety of seeds. Of these the Tree Tomato (*Cyphomandra "betacea*) promises to prove a great success. The seeds germinated "freely, and the plants shot up so wonderfully fast that some of them "are now between 5 and 6 feet in height, without a branch, but the "stems from their greenish appearance seem as if they were herbaceous. "I have given them no particular care, and they have stood the test of "our hot weather very well indeed. I distributed the plants freely to "most of the planters and other permanent residents here."

From a Report to the same Society, dated 29th October 1885, from Mercara, supplied by the Rev. Dr. G. Richter, it is stated :—

"By yesterday's Banghy post I had the pleasure to despatch to your "address three ripe fruits of the "Tree Tomato" (*Cyphomandra "betacea*), and would now remark that in my experience the fruit "answers in every respect the purposes for which the ordinary tomato "is esteemed. As Mr. Morris, of Jamaica, stated in his letter to you in "April 1884, when he sent the seeds, it proved agreeable as chutney, "fried, stewed, and in a tart, and may be useful for jam and jelly. "In using the fruit the rind should be well removed, as it has a

" peculiar and disagreeable flavour ; the pulp itself has a flavour of its " own, pleasantly acid, not like the ordinary tomato, but more resembling " that of the fruit of the *Passiflora edulis*. The plants were grown in " rather damp soil and standing close together. I removed them in " September to different localities, but though full of fruit not one " tree died or suffered. Flowering in May the blossoms set well, and " the fruits stood the monsoon better than I had anticipated, as only " few of the fruits dropped, and some of the young trees bore over fifty. " Now most of the trees show new flowers along with the ripening " fruits, which are larger than those I sent and may fully attain the " size of a duck's egg. I have given away some of the plants and I " hear they prove a success everywhere. So you have secured the " thanks of many for the introduction of this valuable economic plant."

Having noticed than an unfavourable impression had been produced at Madras respecting the growth of the plant and character of the fruit, Mr. Morris addressed the following letter to the Honorary Secretary, dated Kew, 6th July 1886:—

" I notice that in your Report you do not speak very favourably of " the 'Tree Tomato' in Southern India.

" It is quite possible that it may not be quite so good with you as it " undoubtedly is in the West Indies, but, on the other hand, it may be " found on larger knowledge and experience to possess qualities which " may commend it to general approval.

" The fruit should be allowed to fully ripen on the tree. This is an " essential point as regards flavour and size. For cooking purposes all " the seeds should be removed and the outer skin. Then cut the " fleshy part into quarters, and stew or cook as you would apricot or " peach, or make into jam or jelly. If found too acid, steep in boiling " water for a few minutes before using, and the flavour will be much " milder. The planters in Jamaica attribute to it very beneficial " properties as regards liver disease; and indeed my attention was first " drawn to it under the name of 'vegetable mercury.' I cannot say " anything about its medicinal properties for I have had no opportunity " to test them; but I can certainly speak highly of it as a fruit pre- " pared in the manner above described."

A letter to the same effect was forwarded from Coonoor by Mr. Charles Gray, dated August 1886:—

" I notice in the Annual Report for the past year that the 'Tree Tomato' " is said to have proved a failure in Madras as regards the flavour of " the fruit. All I can say is that on the Nilgiris every one that I have " given a fruit to has pronounced it most delicious; and, if the longing " looks cast on the fruits on the tree after one has been given as a trial " are to be taken into account, I quite believe it. Unfortunately my " supply is limited or I could have disposed of hundreds, and if you " have any surplus seed I should be glad of a supply, as I am continually " asked for some. I write this, as I for one (and there are many " others here too) am decidedly in favour of its propagation, it being a " valuable addition to our limited list of really tasty fruits, as well as " being most ornamental."

In a letter dated 14th July 1886 Deputy Surgeon-General Shortt gives further information respecting the plant in the Madras Presidency:—

" Of seeds and plants introduced, the Tree Tomato, or *Cyphomandra* " *betacea*, has proved a great success. The plants have attained from " 10 to 12 feet in height, and are covered with fruits. I have not only

" sent the Society green and ripe fruits at different times, but at the " last flower show I submitted 24 ripe fruits for exhibition. This fruit " promises to become a most valuable acquisition to Southern India " as a vegetable and fruit producing tree. They not only thrive well " on these hills from 1,000 to 5,000 feet, but they have also succeeded " well in Travancore and other localities to which I have distributed " the seeds collected from trees grown here."

* * * * * *

"They might be taken for the Brinjal (*Solanum Melongena*) were it " not for the acid flavour it imparts to a stew or curry. I am indebted " to Mr. D. Morris, Director of the Botanical Gardens, Jamaica, " for a supply of seeds independent of those I received from the Society, " and which I have distributed far and wide."

Dr. George King, F.R.S., Superintendent of the Botanical Gardens, Calcutta, states that Tree Tomato is established at Darjeeling and is a most useful introduction.

It appears also to have been successfully introduced into the North-west Provinces, and is noticed by Mr. Duthie in the following words in his Annual Report on the Saharunpur Gardens for the year 1886 :—

"This plant is thriving as well as could be desired in the climate of " Arnigádh. It has not as yet produced fruit, but I expect to see a " crop this season. It has withstood the winter without any protection, " and has thus proved to be quite hardy at this elevation. The plant is " very ornamental when of full growth, and on this account alone it " would always be worthy of a place in the garden. It is easily raised " from seed, and when it begins to fruit the plant should soon become " common in the gardens. At present the stock of plants numbers 50."

At Hong Kong the Tree Tomato is established, and has produced crops of fruit which, however, owing to unfavourable weather had not ripened during the past year.

XIV.—CHOCHO.

(*Sechium edule*, Sw.)

This is a cucurbitaceous plant well known in Tropical America, where its wholesome fruit is commonly used by all classes as an article of food. In Brazil it is called *Chuchu*, in Jamaica *Chocho*, in the French Islands *Christophine*, in the English colonies *Vegetable pear*, at Madeira *Pipinella*, *Chayota*, or *Chahiota*.

The plant is a climber with three to five-cleft tendrils, and a smooth somewhat stout stem rising from a very large fleshy perennial root having the appearance of a yam. The leaves are heart-shaped, rough to the touch, and five angled. The flowers are green or yellow, with separate male and female flowers on the same plant. The fruit is pear-shaped, about three to five inches long, covered with soft prickles, and either green or cream coloured. The one seed or kernel is like a large thin almond. There are two well-marked varieties, (*a*) with flower and fruit of a pale green colour, and (*b*) with flower and fruit rather larger, cream coloured or white.

As a West Indian plant reference is made to the Chocho by Hans Sloane and Patrick Browne, but it was first described and named by Swartz, Fl. Ind. Occ., Vol. II., p. 1150. It was mentioned and figured by

Jacquin as *Chayota edulis* (Amer. ed. pict. II. tab. 245). Descourtilz places it under *Cucumis acutangulus* (Fl. des Antilles, v. 94, tab. 328) as common in the Island of St. Christopher, and gives a fairly good drawing of the fruit, which, however, has nothing to do with *C. acutangulus*, Linn., now known as the common Luffa. The plant was recently figured and described by Cogniaux in Flora Brasiliensis, Vol. II., pt. 4, p. 111, tab. xxxv. In this the fruit is evidently drawn from dried specimens and is not good. A better illustration of the fruit from a specimen received from Madeira, with a description by the Rev. M. J. Berkeley, is given in *Gardener's Chronicle*, 1855, p. 51.

De Candolle states that "the plant is probably a native of the South " of Mexico and of Central America, and was transported into the West " India Islands and to Brazil in the eighteenth century."

At present it is widely distributed in all parts of Tropical America, and it has also been introduced to Madeira and the Atlantic Islands, from whence the fruit is sometimes sent to the English market under the name of Chayote.

The introduction of this useful plant to some of our possessions in the East Indies was effected during the last two or three years, and already very gratifying accounts have been received of it.

In the West Indies the Chocho is cultivated in the hills, and it flourishes at temperatures ranging from 63° Fahr. to 75° Fahr. It apparently fails in the lowlands, and may therefore be looked upon as requiring sub-tropical rather than tropical conditions. It is easily propagated by planting the whole fruit, which after germination of the seed gives rise to a persistent amorphous rhizome of a woody or a fibrous-fleshy character. The stem can easily be trained to grow over fences or arbours; but failing these it spreads along the ground, and has then much of the habit and appearance of the common vegetable marrow.

The Rev. R. T. Lowe, who met with this fruit at Madeira, mentions (Flora of Madeira, p. 292) that boiled it is a favourite vegetable and highly esteemed. It resembles a young pumpkin rather than a cucumber, but when ripe is somewhat firmer, drier, or more mealy in consistence, with a peculiar nutty flavour. "The larger cream-coloured " or white-fruited variety is better looking, but it is not considered so " good as the green variety."

Macfadyen on the other hand states (Flora of Jamaica, Vol. II., p. 141) that the white variety "is by far the more delicate." He adds, " with the addition of lime-juice and sugar it supplies an ingredient for " tarts; the root when dressed is very wholesome and palatable, and " can scarcely be distinguished from the yam."

Lunan, in 1814 (Hort. Jamaicensis, Vol. I., p. 182), states that "the " fruit is an agreeable, wholesome vegetable, but is much improved by " lime juice, by salt or spicy ingredients. Mixed with lime juice and " sugar it is a good substitute for apple sauce. The vine bears all the " year round and makes very good arbours. The root of the old vine on " being boiled or roasted is farinaceous and wholesome. The seeds (of " which each fruit contain only one) are very good if taken out after " the fruit is boiled and fried with butter."

The introduction of the Chocho to Ceylon was effected by means of the Botanical Gardens in that island. In the Report of the Director for the year 1884, p. 13, it is stated that a case of plants received from Kew in October were all dead on arrival, but that out of a box of germinating seeds sent direct from Jamaica in the following January

one survived, from which afterwards three rooted cuttings were obtained.

In the Report for 1885, p. 11, it is stated that the "Chocho" has been successfully established at Hakgala from the single surviving seed of those sent from Jamaica in January.

Mr. Nock, Superintendent of the Hakgala Gardens, reports :—

"After being nursed up in the propagating house for a few weeks " the plant was put out at the end of February into the nursery. It " commenced to bear in May and has continued to do so ever since, " affording an excellent crop. The vegetable (fruit) it produces is " pear-shaped, and the average weight is 3½ lbs. The plant being " perennial adds greatly to its value.

"As it is the first that has been grown in this country, it may be " useful if I state the best way of cultivating it. It thrives best in a " rich deep well-drained soil, but may be made to grow anywhere by " preparing the site in the following manner :—Make a hole 4 or 5 feet " in diameter and 18 inches to 3 feet deep according to the subsoil. If " the subsoil is good and free you may go to the depth of 3 feet, but " if it is clayey or likely to hold water 18 inches will be quite deep " enough. Place a layer of rough stones at the bottom of the hole to a " depth of 6 to 9 inches for drainage, and over this a few inches deep " of small twigs or half-rotted leaves to prevent the fine soil from " getting between the stones and choking the drainage. The hole may " be filled up with the following compost : one third ordinary garden " soil, one third half-rotted cattle or stable manure (cattle manure pre- " ferred for hot sandy soils, and stable manure for cold clayey soils), " and the remaining third may be formed of leaf-mould, sand, wood " ashes, lime, and the sweepings of the poultry yard, in about equal " portions. When the hole has only been taken out about 18 inches " deep, it will be necessary to raise the soil 18 inches above the ground ; " indeed in every case except in very dry districts it is best to raise it. " The whole fruit, which is sent out in a germinated state, must be " planted about 3 inches deep in the centre of the hole. It begins to " grow at once, and in a week or 10 days it will have made a good " start. It is a creeper, and each plant will require a space of about " 20 feet square."

"The Chocho also does very well at Pérádeniya, but the fruit does not " there attain quite so large a size. I think it will be less suitable for the " lower elevations. I consider it to be a very valuable introduction, and " a real addition to the vegetables of Ceylon. It most resembles the " vegetable marrow, but is, in my opinion, superior in flavour to the best " varieties of that vegetable."

In the Report for 1886 Dr. Trimen mentions that—

"The Chocho of the West Indies (*Sechium edule*) has been widely " distributed and has rapidly become common in the country. It is " liked both by Europeans and by natives, and its easy culture is " especially appreciated by the latter, by whom it is much esteemed for " curries. I have noticed it for sale in the Kandy market at 1c. to 2c. " the fruit."

In a letter addressed to Kew, dated 23rd October 1886, Mr. Nock mentions that—

"The Tree Tomato and Chocho from Jamaica are a great success " here. They are well established in different parts of the island, and " are much appreciated both by Europeans and natives. I should be " much obliged if you will be good enough to use your influence in

" getting for us from Jamaica the *white* variety of the Chocho (what " we have is the green one), and I am under the impression that the " white variety will grow down almost to sea-level, and the green one " here begins to feel uncomfortable below 2,000 feet."

The Chocho has long been established at Darjeeling, and according to Dr. King is very common there. From thence it has recently been introduced to Saharunpur, and is noticed as follows in the Report of Mr. Duthie for the year 1885 :—

" *Sechium edule* is called 'Chocho' in the West Indies, where it is " cultivated. Both the fruit and root are eaten. The fruit is oblong, " about 4 inches long, and is considered to be wholesome and fattening. " The large fleshy root, sometimes weighing as much as 20 lbs., is " said to resemble a yam when cooked. The seed was sent to me from " Darjeeling by Mr. Gammie, who has successfully cultivated the plant " in his garden."

In the Report on the Saharunpur Gardens for the year 1886 it is stated that—

" The peculiar cucurbitaceous vegetable, the 'Chocho' of the West " Indies, has taken kindly to the climate of Arnigádh, and is likely to " prove a useful addition to our varieties of vegetables. Four plants " were raised last year from seeds received from Mr. Gammie, Darjeeling, " and as these ripened fruits the stock is now increased to 20 plants. " It is expected that these will produce sufficient fruit this season for " sowing a moderate-sized plot. As each fruit contains only one seed, " the plant cannot be so quickly propagated as other cucurbitaceous " plants, hence a stock sufficiently large for distribution requires time " for production."

In Mr. Morris's Report on the Island of St. Helena, dated January 1884, attention was drawn to the desirability of introducing the Chocho to that island as a valuable and hardy vegetable.

Subsequently arrangements were made with Dr. Michael Grabham, of Madeira, for the despatch of Chocho fruits from Madeira to the Governor of St. Helena. Unfortunately the first lot kindly sent by Dr. Grabham miscarried, but in November of 1886 another lot was sent, and from a letter from the Acting Governor, Colonel Blunt, R.E., to the Colonial Office, dated 12 February 1887, it appears that "many of the plants are now growing."

In the Appendix to the Report of the Superintendent of the Botanic Gardens, Singapore, for 1885, it is stated that the Chocho "established " on Penang Hill in general excellence far surpasses all other cucumbers " grown in the Straits."

A plant of the Chocho is growing on the eastern side of the Succulent House at Kew, and several small plants are in the Temperate House. The large plant fruited the first year after it was imported, but it has never fruited since, although it is growing well. When the fruit is allowed to remain on the plant the seed germinates and develops both leaves and roots *in situ*. Specimens of fruits of Chocho are in the Kew Museums, presented by L. A. Monteiro, Esq.; from Mexico, presented by D. Hanbury, Esq.; from Venezuela, under the name of *Challote o' Chayote*, presented by the Goverument of that Republic; and starch prepared from the root of Chocho at Jamaica, presented by Dr. Macfadyen.

XV.—ARRACACHA.

(*Arracacia esculenta*, De Candolle.)

The Arracacha is a valuable esculent common in the high lands of Venezuela, where it is regularly used as an article of food. The plant belongs to the natural order Umbelliferæ, and in appearance and habit of growth resembles the common parsnip. It is called in Spanish *Apio*, from its resemblance to the celery, as a substitute for which the blanched shoots can be used. The root is a fleshy tuber of large size, bearing numerous knots or tubers on the outside.

Of these the shoots on the upper surface inclining upwards give off leafy growths, marked about the base with horizontal rings bearing membranous sheaths, which afterwards wither away. These shoots when ripe can be broken away from the parent tuber and form new sets for planting. The other shoots, which are given off below the ground, are generally eight to ten in number; the largest measure about 6 inches long by 1½ to 2 inches in diameter. They are nearly of the same circumference throughout, tapering off suddenly and sending out a few fibres at the extremity. Their surface is nearly smooth, covered with a thin skin, marked across with transverse scars, like the roots of carrots. These underground shoots are called *hijos* (sons), and are the edible portions of the root, being more tender and more delicate in flavour than the main root or *madre* (mother).

The stem is 2 to 4 feet high, often streaked with purple. The leaves, rising directly from the root with long petioles, are deeply and irregularly pinnatifid. They are dark green and shining above, paler beneath. The flowers borne in umbels are of two kinds; those in the centre are imperfect or bear stamens only, and have a flat disk in the centre.

The origin of this plant is uncertain. It is generally cultivated in Venezuela, New Granada, and Ecuador as a nutritious food plant. De Candolle states that "the species is probably indigenous in the "region where it is cultivated, but I do not find in any author a "positive assertion of the fact. The existing descriptions are drawn "from cultivated specimens."

"The best information about the cultivation of this plant was given "by Dr. Bancroft to Sir William Hooker, and may be found in the "*Botanical Magazine*, tab. 3,092. A. P. de Candolle published in "*La 5° Notice sur les Plantes Rares des Jardin Bot. de Genève* an "illustration showing the principal bulb."

From notes supplied to Kew in October 1882 by Mr. D. Morris, who had cultivated the Arracacha at Jamaica, we find that it is propagated either from seed or from "sets," the latter being offshoots from the main stem, which are freely produced, and grow with great facility. The valuable part of the plant is the root. During growth this gives rise to a number of small tubers or "fingers," eight or ten in number. The largest are from 8 to 9 inches in length, and about 2 inches in diameter. They are yellow or white in colour, with a smooth surface, and marked, like the carrot, with transverse scars. At Bogota, the main root is styled the *madre*, while the young edible tubercles or fingers are called *hijos* (or sons). The younger fingers are considered the best, the older ones being fibrous and strongly flavoured.

The plant grows in almost any soil; it prefers, however, rich cool hollows, and in such situations is most prolific. It will even grow in stiff clay soils, as well as in those of a light sandy character, but under such circumstances the yield is not so great. At the Government Cinchona

Plantation, Jamaica, it is planted in ridges, like potatoes, about a foot or 18 inches apart.

The first crop takes from eight to ten months to mature; but, being perennial, fresh shoots are continually thrown out which give a succession of crops for several years. It would, however, be better to plant fresh "sets" at the beginning of every rainy season, and so secure a constant supply of young fingers.

To prepare Arracacha for the table, the roots are first scraped and then boiled; a little salt should be added; and if the roots are not quite young it is customary to change the water once or twice. After being boiled, they may be grated and employed as an ingredient for thickening soup; or, better still, mashed, mixed with pepper, salt, and a little butter, they form a most palatable dish.

Dr. Bancroft describes the following method of cultivating this plant at Bogota:—After separating the upper tubers, or knobs, from the root, detach from these the offsets, singly, each with its portion of the substance of the tuber, which is then to be pared smoothly all round at the bottom, the outer leaves being stripped or cut off, so as to leave a sprout from half to two or three inches at the most. If any germs or eyes be seen at the base of the offsets, these must be carefully cut out. Thus prepared, the shoots are planted in loose mould, in a slanting direction, at distances of 15 or 18 inches from each other, whether the ground be level or sloping. Afterwards, at intervals of about two months, the soil ought to be weeded; and when the plants have attained the height of 10 or 12 inches, or whenever they show a disposition to blossom, the budding tips should be taken off, as the process of flowering would hinder the root from coming to its greatest size, care being taken not to remove more than the budding extremities, lest the growth of the root should thereby also suffer; with the same view, any luxuriance in the shoots ought to be prevented, since it must be at the expense of the root. From time to time, and particularly after weeding the ground, fresh mould should be laid round the foot of each plant, to aid likewise in the enlargement of the root.

From a letter addressed to the British Consul-General at Bogota by Mr. Henry Burchall in 1878, it is gathered that Arracacha requires from 10 to 12 months to reach maturity, but the tubers may be gathered two months earlier if much wanted. In this case the produce is of course smaller, but it is said to be equally wholesome and agreeable to the taste. Mr. Burchall mentions that old or central portions of the root are never planted a second time, as they produce the *macho*, or a flowering stalk, and not edible roots. If seed is used instead of "sets" it would take two or three seasons before the plants attain their full growth. With ripe "sets," as mentioned above, the mature crop is reaped in 10 to 12 months.

A full account of the Arracacha is given by Diaz in *El Agricultor Venezolano*, from which we take the following notes:—

"The Arracacha is indigenous to Venezuela and New Granada, and
" belongs to the family of Umbelliferæ.

"Botanists have distinguished it by the name of *Arracacha esculenta*,
" preserving thus its primitive Indian denomination, and it was the
" first Spanish Colonists who called it Apio, generalising this name in
" such a fashion that many Venezuelans do not now know what the
" Arracacha is.

"It is raised generally from division of the crown or rootstock,
" provided with buds or shoots, and also from the seed, though less
" advantageously from the latter.

"If it be requisite to raise from seed, a seed-plot must be prepared " and care taken that there is no lack of watering; the young plants " must also be thinned out where very crowded. When it is time for " transplanting the seedlings no more plants should be taken up than " can be planted within the time, and they should be put meanwhile into " water so that the roots are kept wet and thus unite better with the " soil. The proper temperature is that of the cool zone at a height of " 2,000 varas (yards), and the soil requires to be light, containing " plenty of leaf-mould (humus) and well worked, as is necessary for all " tuberous plants grown for their roots. It can be cultivated down to " 500 varas (yards) but to little advantage, results improving gradually " with the ascent from that level.

"The proper season in natural non-irrigated lands is in the two " springs of May and October, but in irrigated and highly cultivated " ones sowing or planting can be done at any time, the plant being kept " well weeded, watered, and earthed up like garden plants. If three " months after planting they are tied up like endive, the shoots become " blanched and can be employed as salad or be stewed.

"The ordinary use which we make of the Arracacha, which we call " also Apio, is to boil it or use it for forced meats or fritters. This root " yields a large quantity of starch, and is preferred to "sulu" for the " sustenance of invalids. It is in season at the fourth month.

"The Arracacha requires a black soil, light and deep, which favours " the development of the roots. To propagate it, it is cut in pieces, " each with an eye or bud, and these are planted separately. After three " or four months' growth the roots are sufficiently developed for use " in the kitchen; if left in the ground for a longer period they acquire " greater volume without depreciation of flavour.

"The colour is white yellow or purple, but these variations do not affect " the quality. The Arracacha which is most esteemed is produced in " Lipacon, a small town situated two leagues north of Santa Fè de " Bogota.

"The Arracachas, like potatoes, do not thrive in very warm localities, " in such places they form much leafage, but the roots are poor and " insipid; in temperate regions the produce is regular, but increases " considerably in the cooler parts of Columbia, in which the medium " temperature is 58° to 60° Fahr., equal to 12° Réaumur and 15° " Centigrade. It is there that the root develops best and acquires the " most delicious taste.

"The flavour is agreeable and slightly sweet; the odour is peculiar, to " some people very pleasant but very repugnant to others. Amongst " animals this repugnance to the smell is not remarked; on the " contrary, it appears to be exceedingly agreeable to them and to excite " their appetite, since immediately they smell it they show a lively desire " to eat, and all devour it with avidity and eagerly seek it. I have " observed that animals can consume large quantities of the Arracacha " in their daily ration of food without, in a single case, the least repug- " nance being remarked.

"In connection with the importation of foreign cattle, the Arracacha " is of all plants the most valuable, since in the transits from Honda " to Bogota it is the forage which they accept with the greatest avidity, " and that which enables them the soonest to recover from the poor " condition in which they arrive. During the first months, whilst " they are becoming acclimatized, the Arracacha is almost the only food

" which will satisfy them, and they prefer it to green grass, hay, or any " other forage.

" When the crop is collected the roots with buds are separated and " preserved for some days in order to form with them a new plantation; " but before planting them in the ground for development it is necessary " to shorten the stem attached to the bud to about an inch, because " it is said that if this precaution be not taken the plants will not yield " Arracachas nor acquire the same development as they do when sub- " jected to this mutilation. Furthermore, the leaves are suppressed " which have already been formed; at the time of planting they are " cut off at about two to three inches from the collar.

" Among the cultivated Arracachas we have distinguished three chief " varieties; the yellow, to which probably is due its name of xanthorrhiza, " which is not applicable to the other; the white, so called because " the root is perfectly white, like some radishes and turnips; and the " violet or mulberry-coloured (morada), which is also white but has a " violet or mulberry-coloured ring around the insertion of the crown, or " similarly coloured spots upon the widest parts.

" The yellow is the most common and almost the only sort cultivated " in many localities; it yields the largest crops, whether in numbers " of roots or in their individual bulk. Of all the varieties the yellow is " the most robust and resists best the inclemencies of the weather, but " unfortunately it is also the tardiest grower.

" The white is much in demand amongst connoisseurs, as it possesses " a more agreeable flavour, softer texture, and other culinary advantages; " amongst the cultivators it is esteemed for its precocity, although it " suffers more than the yellow when the meteorological conditions are " not favourable, and its yield is always less as regards weight.

" The violet or mulberry-coloured (morada) appears to possess the " same qualities as the white, and to resemble that variety very closely " both with respect to its merit as an esculent and as regards its cul- " tivation."

The attention of the Government of India having been directed to the value of Arracacha as a possible food plant for certain hilly districts of that country, several attempts were made to introduce it by seed and offsets. In a letter addressed by the Director of the Royal Gardens, Kew, to the India Office, dated the 4th January 1886, the introduction of the Arracacha to India is reported as follows:—

" Referring to the letter addressed, 1st January 1879, to Sir J. Hooker " by Mr. F. C. Danvers, respecting the transmission of tubers of " *Arracacha* to India, I have now to inform you that the various " attempts which have from that date been made to introduce this South " American esculent into India have at last been rewarded with " success.

" No result of any importance was apparently obtained from the " supply of tubers obtained through the Foreign Office from Bogota, " nor from the seed obtained through the same source and transmitted " to India from Kew in the following year.

" In 1882, it was ascertained that the *Arracacha* was naturalised on " the hills in Jamaica, and Mr. Morris, the Director of Public Gardens " and Plantations in the Colony, stated that he believed it 'to be a most " valuable food-plant,' and that for his own part he not merely liked " it, but found it to become more palatable and desirable the longer it " was used. He added—

" 'If the natives of India take to it as an article of food, I can con- " ' ceive nothing more likely to flourish in the hill districts, and to

" ' afford, with little labour, the means of sustaining life under adverse
" ' circumstances.' "

"A supply of tubers received at Kew from Jamaica was sent in 1883
" to Saharunpur, Ootacamund, and Ceylon, and in 1884 to Calcutta,
" for Darjeeling. Mr. Lawson, Director of Government Cinchona
" Plantations, Parks, and Gardens, Nilgiris, reported in 1884 that plants
" had been raised from the tubers sent from Kew. The result in the
" other two botanical establishments in India has not reached us.

"From Ceylon Dr. Trimen has recently reported that he has raised the
" *Arracacha* from seed obtained direct from Jamaica. He appears to
" have obtained the tubers without difficulty and in abundance. As a
" matter of taste, he has a less favourable opinion of them than Mr.
" Morris. But the point to which I wish to draw your attention is
" that the introduction of the esculent into India is accomplished, and
" that its further diffusion need present no difficulty."

In the Report of the Director of the Botanical Gardens, Ceylon, for 1884, the Arracacha is mentioned as "an umbelliferous plant, native
" probably of the Andes of South America, where it is cultivated up to
" 6,000 feet, was introduced into Jamaica in 1822, and produces large
" edible starchy roots, with the flavour somewhat of parsnip. Two or
" three attempts to import the roots in a living state into Ceylon have
" proved completely unsuccessful; but Mr. Nock has now succeeded in
" raising some young plants from seeds sent from Jamaica, which it is
" hoped will in time develop the edible portion."

In the Report for the year 1886 it is stated that—

"The Arracacha is not generally liked by Europeans (though some
" like it), but much enjoyed by all the natives who taste it. Mr. Nock
" reports a good stock at Hakgala, and I am prepared to distribute
" through the Government Agents small quantities to the headmen of
" villages at 2,000 feet or more elevation, in the hope of its culture being
" taken up by the villagers. Much interest has been excited in India
" by the successful introduction of this vegetable in Ceylon, and in
" answers to applications we have sent boxes of the roots to the Botanic
" Garden at Saharunpur, the Agri-Horticultural Society of Calcutta,
" and the Chief Commissioner of British Burmah."

Dr. King, in his Report on the Calcutta Botanic Gardens for the year 1886, mentions that—

"A small supply of the tubers of an eatable, umbelliferous plant named
" *Arracacha esculenta* were sent to this garden from Kew two years
" ago. As the climate of Calcutta was considered unsuitable for the
" cultivation, these tubers were sent to Mungpor, where, under Mr.
" Gammie's care, some of them are now thriving well. As the tubers
" are still few in number and too precious to be sacrificed for food, I
" have not tasted this new vegetable."

In the Report of the Superintendent of the Saharunpur Gardens for the year 1881, under Arracacha it is mentioned that—

"The seed of this new kind of vegetable was sown in this Garden.
" The result is eleven plants; none are sufficiently grown yet to say
" more of them than that they look quite healthy."

In the Report for 1883 it is stated that—

"Of the valuable South American vegetable Arracacha there are a
" few plants still left, and they are in a fairly healthy condition."

Arracacha plants are under cultivation at Kew, but it is not possible to produce good tubers, owing to the short period during which they can

be cultivated in the open ground. They have failed also in France and in the South of Europe (*The Vegetable Garden* by MM. Vilmorin-Andrieux, p. 3). Specimens of the edible roots are in the Kew Museums from Jamaica, 1884, presented by Mr. D. Morris; from the Botanical Department, Jamaica, Colonial and Indian Exhibition, 1886; and there is a specimen of starch prepared at Jamaica from Arracacha presented by Dr. Macfadyen.

XVI.—CHERIMOYER.

(*Anona Cherimolia*, Mill.)

This is a sub-tropical member of the genus Anona, a native of the Andes of Eucuador and Peru. Like the species which yield the sweet-sop, sour-sop, and custard-apple, the Cherimoyer is a tree of about 15 feet to 20 feet high, with loose spreading branches and velvety leaves. In botanical character it appears to hold a place between the sweet-sop (*A. squamosa*) and the custard-apple (*A. reticulata*); the leaves partake of some of the character of both, and the fruit is somewhat scaly like that of the former, and reticulated like that of the latter.

As in most plants which have been a long time under cultivation, there are numerous varieties more or less differing as regards the size and character of the fruit, but it is generally agreed that the Cherimoyer is the most delicious of its kind, the flesh being firm, of a flaky character, and possessing a slightly agreeable acidity mingled with a luscious sweetness. The flowers are pendant and velvety; they are generally closed in the day and open at night, giving out a delicate odour resembling that of *Magnolia fuscata*. On this account they are said to be put into snuff as a substitute for the Tonquin bean. The fruit is usually the size and form of the sour-sop, of a light green colour, with a snowy-white pulp and black seeds.

De Candolle, discussing the origin of this species, states that "the "Cherimoyer is mentioned by Lamarck and Dunal as growing in Peru; "but Feuillée, who was first to speak of it, says that it is cultivated. "Humboldt and Bonpland saw it cultivated in Venezuela and New "Granada; Martius in Brazil, where the seeds had been introduced "from Peru. The species is cultivated in the Cape Verde Islands and "on the coast of Guinea. Its American origin is evident. Claude Gay "says that the species have been cultivated in Chili from time imme-"morial. In conclusion, I consider it most probable that the species "is indigenous in Ecuador, and perhaps in the neighbouring part of "Peru."

A rough drawing of the fruit is given by Feuillée, Journ. des Obs., Vol. II., p. 24, tab. 17; the leaves and flowers are figured in Bot. Mag., tab. 2011, under the name of *Anona tripetala*, Ait. The only recent figure intended to be given is by Rodigas in *L'Illustration Horticole*, N.S., pl. 563, but in colour and the absence of reticulations and of the subsquamate character inseparable from the Cherimoyer this figure more nearly resembles that of the custard-apple (*A. reticulata*).

The Cherimoyer is very common in the mountains in Jamaica, and it must have been introduced there many years ago. It requires such sub-tropical conditions as are connected with a mean annual temperature 78° to 63° Fahr., an annual rainfall of about 80 to 100 inches, and a fairly rich soil.

It is fairly abundant at Madeira, whence the fruit arrives in the autumn to the English market. It is also found at St. Helena and on the coast of Guinea, and its introduction to the mountainous districts of Ceylon and India has now been assured.

There is a tall plant under cultivation in the warm Economic House at Kew, but it has not flowered or fruited here. Specimens of Cherimoyer fruits are represented in the Kew Museums from Lima, presented by Sir Spencer St. John; from Botanical Department, Jamaica, Colonial and Indian Exhibition, 1886; and a fruit grown at Wallington, Newcastle, presented by Sir W. Trevelyan.

Seed of the Cherimoyer in large quantities were sent from Jamaica to Ceylon, and in the Report of the Director of the Botanical Gardens for the year 1884 it is mentioned—

"There is a good supply of seedling Cherimoyer trees available at "Hakgala. The fruit of this tree is considered to be far superior to the "other species of the genus Anona (the custard-apple, sweet-sops, &c.), "but the tree is adapted only to the hill climate in Ceylon."

In the Report on the Saharunpur Gardens for the year 1885, Mr. Duthie states :—

"A case containing 13 lbs. of seeds of the Cherimoyer of Peru "was lately received from Mr. Morris, Director of Public Gardens at "Jamaica. Many of the seeds were useless owing to their having "germinated on the way, but a fair proportion arrived in good order "and are now appearing above ground."

It would appear that in Southern India the Cherimoyer was introduced many years ago, and Deputy Surgeon-General Shortt gives the following account of it in a letter to the Agri-Horticultural Society of Madras, dated 27th September 1884 :—

"I am sending you by this day's sample post 18 seeds of the Cherimoyer "(*Anona Cherimolia*). The seeds of this fruit were originally sent "from Spain by retired Colonel R. Hunter to the late Captain Short on "these hills, who successfully grew several plants, which were distributed "among his sons up here. I also received a plant out of some 18 or "20 plants. One plant fruited freely this season, and seeds from it I "now have the pleasure to send the Society.

"The fruit I received was the size of a double fist or that of a large "cocoanut, quite round, with a yellowish tinge of green colour, sub-"squamous and reticulated. In other respects it had all the appearance "of the common custard-apple, with a most delicious and delicate flavour, "and I hope you will be able to raise plants from the 'pips' I send "you."

Diaz, in *El Agricultor Venezolano*, mentions that the fruit of the Cherimoyer is very much appreciated, and its taste very pleasant, especially in cool districts in the hills, where the temperature suits it best. It is used for dessert, like the medlar, peach, &c. &c. The external portion of the husk is said to contain an active acid. The pulp is employed as a medicine for the alleviation of inflamed ulcers and for the maturing of abscesses. The seeds of all the species of this genus when reduced to powder are used for destroying insects.

D. M.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 9.] SEPTEMBER. [1887.

XVII.—ANNATTO.

(*Bixa Orellana*, L.)

In *Bulletin* No. 7, for July last, information was given as regards Annatto which appears to have drawn attention to its present position as an article of commerce. Amongst other communications, we have received from Messrs. Fulwood and Bland, Annatto manufacturers, of 31, Bevenden Street, Hoxton, the following notes, which will usefully supplement what has already been published on the subject :—

The great bulk of Flag Annatto comes from Cayenne and Guadaloupe in the form of a paste made into cakes of about 8 or 10 lbs., which are wrapped up in banana leaves and packed in casks weighing about 5 cwt.

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each. The best kind is that from Cayenne, but it varies very much in quality, so much so that its value at the present time ranges from 5*d.* to 1*s.* 8*d.* per lb. ; it also fluctuates very much in price according to the seasons. The Guadaloupe Annatto is very inferior, being very sour, but bright in colour in consequence of the acid that the natives put into it ; it is, however, of very little value for manufacturing purposes, and therefore never realises such a high price as Cayenne Annatto ; moreover, it does not contain anything like the amount of colouring matter present in the Cayenne kind. Annatto seeds principally come from the West Indies and Ceylon. We have never heard of any being imported into this country from Cayenne or Guadaloupe, the best that we have seen have been from Jamaica ; they vary very much indeed in quality in consequence of insufficient care in collecting, curing, and drying them before exportation. Large quantities came into the London market last year very much deteriorated in value in consequence of having been packed when damp and getting heated and mouldy, the colouring matter was seriously damaged, and a good deal arrived shrivelled up and broken into small particles (evidently gathered before quite ripe), which is very objectionable for manufacturing purposes. We bought seeds last year in London at 1½*d.*, 2*d.*, 2½*d.*, 3*d.*, 4*d.*, and 6*d.* per lb., and those at 6*d.* were much the cheapest for our purpose, since the labour and expense with bad seed is just the same as with the best quality.

The supply of seeds on the London market always has been very intermittent, so that we cannot rely upon a constant and regular supply every season, and last year we ordered two tons of some Kingston merchants which they could not supply. We are, therefore, decidedly of opinion that good, sound, hard, whole Annatto seed, properly collected and dried, free from mould, would meet with a ready sale in this country at such a price as would pay the growers well. If, however, they would only prepare the Annatto in the same way as they do in Cayenne, by washing the colouring matter off the freshly gathered seeds, and send it over here in cakes or in a semi-fluid form, it would be better. We are quite sure that it would pay them well to do so, as it would fetch a very much higher price than the Guadaloupe kind realises, and we should be securing an industry for our own Colonies that is now entirely in the hands of the French. This is the reason why nearly all the Flag Annatto is sent to France, to encourage their own shipping, and the French merchants make a good profit out of it before it reaches us. If, therefore, it answers the French Colonists' purpose to prepare the Flag Annatto and export it to France, surely it would pay the growers of Jamaica and Ceylon to do likewise and export it direct to us, they would then get a better price for it than the Cayenne growers do, because they would save the intermediate profits of the merchants in Cayenne and France. They ought to be able to prepare the Flag Annatto in Jamaica and Ceylon quite as well and as cheaply as the natives do in Cayenne ; but it would not do for us to attempt it in this country from imported seed, because there is first the cost of freightage over here, and labour is too dear to attempt to compete with the natives of Cayenne in washing the colouring matter off the seeds. You will therefore, understand that we can buy the Flag or paste Annatto very much cheaper than it would be possible for us to prepare it ourselves in this country. Annatto seeds of best quality will consequently never fetch more than about 5*d.* or 6*d.* per lb. because of the competition with the Flag Annatto. Lisbon Roll Annatto is another kind that comes from Para, it is in a paste packed in baskets weighing about ¾ cwt. each. It is wrapped up in dried leaves, and is principally used

for colouring butter, being of no use whatever for colouring cheese; this also varies very considerably in quality. We bought it last year from 2*d.* to 1*s.* 9*d.* per lb. according to quality.

It has long been evident to us that sufficient care is not taken in washing the colouring matter off the seeds, and in preparing the Flag Annatto for the market we often find that it is very much adulterated with farinaceous and other substances to increase the bulk, which frequently causes a large amount of trouble to the manufacturer. We, in fact, seldom find two casks alike in quality or colour, and it is frequently kept until fermentation and decomposition set in, which of course destroy the colour; some that we had from the Polynesian Islands consisted simply of the colouring matter washed from the seed without admixture of any foreign substance. It was in a semi-fluid state and very pure, but a little dearer than Cayenne Annatto, and we cannot see any reason why the growers in Jamaica and Ceylon should not be able to teach the natives how to prepare it in this way, and we could then take large quantities of this kind of Annatto annually, and probably all that they could make. We would suggest that some of the growers should make the experiment and send us samples, and we would let them know how much we could give for it and the quantity we would take annually.

The consumption of Annatto throughout the world is of course limited. Our business has been established over 100 years, and for the last 50 years our importation of Annatto has not varied very much. Last year our imports of Annatto of the various kinds amounted to over 50,000 lbs., the great bulk of which was Cayenne Flag Annatto. Had we used the seeds only we should have required at least 200,000 lbs. for our business alone.

Annatto is principally used for colouring cheese and butter, for which purpose it has to be specially prepared so as to be perfectly pure and harmless when it reaches the consumer.

The following are among the many preparations of Annatto manufactured by us, specimens of which have been presented to the Kew Museum :—

Imperial Black Cake Annatto.
Treble Strength „ „
Extra Superfine „ „
Superfine Orange „ „
Fluid Extract of Annatto.
Butter Colouring.
Butter Colouring prepared in oil.
Roll Annatto, Spanish.
Cayenne Flag Annatto.
Lisbon Roll Annatto.

These are used for a variety of purposes, viz., for colouring jellies, hair, soap, candles, scent, spirits, confectionery, leather, pomades, chocolate, and in making lacquer for brass work, and dyeing calico, silk, wool, skin, rugs, straw-plait, feathers, wood, ivory, bone, &c., and also as an auxiliary in giving a deeper shade to the simple yellows.

Dyers also use the raw Flag Annatto very extensively for a reddish colour. It is not generally known that two colours can be obtained from Annatto, yellow and red.

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Since the receipt of the foregoing some extracts from the reports of American Consuls in various districts in South America on the subject of Annatto have appeared in the *Pharmaceutical Journal* for July 16th, 1887, p. 51. In Para, Consul Clayton states that it is the practice to allow the fruits to remain on the tree till wanted for use, the capsule does not readily burst, and the seeds remain for a long time in good condition. "With the most careless culture two full crops can be "gathered every year.

"The pigment is extensively used by the Indians in dyeing the "threads of hammocks, and by the wild Indians for painting their bodies, "they mixing with it turtle oil or the fat of the *peixe-bois* (manatee). "In Para it is sometimes used to give colour to cooked rice, but I have "never heard of its being so used on the Amazon. An infusion of the "leaves drunk hot is considered by the Indians a remedy for jaundice.

"The quantity of Annatto exported to the United States from this "consular district during the last two years amounted to 27,435 lbs. "and valued at 6,816 dollars."

From Barranquilla Consul Vifquain reports that "the natives use "the Annatto for colouring purposes. They are very fond of colouring "victuals for the table here. It adds nothing, however, to its quality. "The Indians use it as a defensive armour against the frisky and still "more pugnacious mosquito. They crush the seeds and anoint their "naked limbs with the stuff."

In Porto Rico Consul Conroy says that "the country working people "are fond of having planted near their little homesteads two or three "shrubs for the sake of the fruit, which they use as a condiment in "colouring and seasoning their messes of rice and other food in place "of saffron or red peppers.

"A very small quantity of Annatto is exported from this province "either to Spain or the United States, but no other preparation is given "to the article than merely drying the pods in a current of air under "shelter from the sun, and then packing them in bags or barrels."

XVIII.—NOTES on Articles contributed to the Museums of the Royal Gardens, Kew, from the Colonial and Indian Exhibition, 1886.

In no previous exhibition held in London, not even including the first Great Exhibition of 1851, were the vegetable products of the British Colonies and India so fully represented as they were at the Colonial and Indian Exhibition of 1886. In the London Exhibition of 1862, and in the Paris Exhibitions of 1867 and 1878, the timber resources of the countries represented were very fully shown. The collection of Colonial and foreign timbers now contained in Museum No. 3 of the Royal Gardens, most of which were procured from the exhibitions above referred to, will be sufficient proof of this; many of these specimens are unique both in size and figuring when polished.

At the Colonial and Indian Exhibition last year, though woods were by no means omitted, other vegetable products, both raw and manufactured, were the most prominent. This was particularly the case in the collection of fruits from the different Colonies, and specially from the West Indian Islands.

The Kew Museums have always benefited largely from the several exhibitions, and, as might be expected, in no previous year have they been so extensively enriched as they were at the close of the exhibition last year; and this not only from the number of the specimens obtained, but also from the interest attached to many.

The following are some of the principal additions:—

CANADA.

The Canadian collection occupied a much larger portion of space than that given to any other individual possession. It was especially rich in timbers; but notwithstanding promises of assistance from the High Commissioner and other authorities at the exhibition, to help Kew to obtain what was required for the Museums, none of the timbers were available. The following were the only specimens received:—

Cranberries.—The fruits of *Oxycoccus macrocarpus*. American cranberries are imported into London and other parts of Europe in large quantities, as they bear the voyage without injury, and are generally preferred in this country to the native cranberry (*Oxycoccus palustris*), the berries of which are smaller, and not so bright a red as the American species.

Buffalo berries (*Shepherdia argentea*).—In the ripe fresh state they are of a bright orange colour, and are used for making tarts and preserves. The mealy pulp of the dried berries is also eaten.

From N.W. America several interesting articles of native manufacture, including a mask, a huge whistle, spoon, &c., made of the even grained wood of the **Native Cedar** (*Thuja gigantea*), were procured, also a native head-dress made of the bark. This bark is remarkable among the Coniferæ for its fibrous character, and is so strong that mats are made from it, and when twisted and plaited it forms a good basket making material.

NEW SOUTH WALES.

The Kew Museum being already in possession of a very fine set of woods and other vegetable products from this Colony, little or nothing was required or obtained for the collection, except a sample of **Pulu**, a soft woolly substance from the base of the leaf stalks of *Macrozamia spiralis*, a Cycadeous plant of New South Wales and Queensland. This substance is said to be produced in quantities, and used for stuffing mattresses, cushions, &c.

VICTORIA.

From the Victorian Commission were obtained a fine series of **Oils and Resins**, of several species of *Eucalyptus* the former being the special preparations of Mr. Joseph Bosisto, of Melbourne, President of the Commission in London, who has made a speciality of the preparation of Eucalyptus oils.

The following may be enumerated:—

Essential oil of *Eucalyptus amygdalina*, rectified and non-rectified. This species forms the highest of all known trees, one specimen having been found in Victoria measuring 470 feet high.

Essential oil of Eucalyptus of commerce. This is obtained from varieties of *E. amygdalina*, the leaves of which are not readily distinguishable by the bushmen who collect them These oils are very

powerful antiseptics, disinfectants, and deodorants, and are also used as rubefacients.

Essential oil of *Eucalyptus Globulus*, the Blue Gum tree of Victoria. It has tonic stimulant and antiseptic properties. It is stated that in Mr. Bosisto's factory in Western Gippsland 12,000 lbs. of Eucalyptus oil are annually produced, and as many as six tons of Eucalyptus leaves are manipulated daily.

Resin of *Eucalyptus rostrata*. The Red Gum of Victoria, described as a "thoroughly soluble and delicate mucilaginous astringent."

Resin of *Xanthorrhœa australis*, **Grass tree** of Australia. This resin is deposited on the trunks in large quantities at the bases of the fallen leaves. It is of a deep amber colour, and is used for staining woods, and in England for mixing with varnishes.

Resin of *Acacia decurrens* [*A. mollissima*]. This is of an astringent character, and is known as **Australian Catechu.**

Opium prepared from poppies (*Papaver somniferum*), grown in Victoria; it yields 10 per cent. Morphia.

WESTERN AUSTRALIA.

Timbers formed the principal exhibits from this Colony, the most remarkable of which was a log of **Jarrah** (*Eucalyptus marginata*). This log measures nearly 10 feet long by 4 feet 6 inches diameter, and contains 148 cubic feet. Its weight was nearly five tons.

A magnificent specimen of Curly Jarrah, which has dark, wavy transverse markings was also shown. It measures some 15 feet long, by about 2 feet 6 inches wide, and was cut and polished for a counter top. Both these specimens were very liberally presented to the museum of the Royal Gardens by the Western Australian Commission. Jarrah wood has attracted a considerable amount of attention of late years, as it has the reputation of being the most durable of all woods for moist or damp situations, as well as being equally lasting in dry positions. It bears, it is said, not only changes of temperature without injury, but it also resists the attacks of Teredo, White Ant, or any similar destructive agent.

The following woods were also presented to the Kew Museum by the Commissioners for this Colony.

Karri (*Eucalyptus diversicolor*).—A tree 80 to 100 feet high, the wood of which is of a deep reddish brown colour. Very hard and considered by some to be as durable as Jarrah.

Wandoo (*Eucalyptus redunca*).—A tree varying in size, but never growing to a great height. The wood is of a lightish red colour, very hard and durable, and is much used for cart shafts, spokes, cogs, rollers, naves, felloes, and railway waggon building.

Morrell (*Eucalyptus longicornis*).—Sir F. Von Mueller says this may probably be a variety of *E. oleosa*, from which it differs, however, in its comparatively tall stature, attaining a height of 120 feet or more. The wood is nearly as dark in colour as the Jarrah; it is extremely hard, and used for rafters, shafts, naves, spokes, harrows, and all kinds of wheelwrights' work. The leaves are said to be rich in oil.

Tuart (*Eucalyptus gomphocephala*).—A tree 40 to 50 feet high, the wood of which is strong and durable, and used for shafts, naves, and felloes of wheels, shipbuilding, railway waggons, &c.

York Gum (*Eucalyptus loxophleba*).—A tree seldom exceeding 80 feet high usually of very straight growth. Of the wood Sir F. Mueller

says, "it is regarded as the very best in West Australia for naves and "felloes on account of its toughness, though not sufficiently fissile to be "split into rails; it is for this very reason preferentially sought for "many superior purposes by artizans."

Raspberry Jam Wood (*Acacia acuminata*).—The produce of a tree 30 to 40 feet high, obtainable in considerable quantities. The wood is used for fencing posts, for which it is considered very durable; the dark colour and scented character of the wood however recommends it as a likely wood for cabinet work.

Sandalwood (*Fusanus spicatus*).—A tree 30 feet high, the wood of which is of a yellowish brown colour, close, even grained, and hard. It furnishes the bulk of the Australian Sandalwood, a very lucrative export trade in which has for years been done, principally with China. Three fine plants of *Kingia australis* in flower were also presented to the Museum. These singular plants belong to the natural order Juncaceæ, and the stems sometimes grow to a height of 20 feet.

FIJI ISLANDS.

A large and interesting collection of vegetable products were exhibited from these islands, a fine series of which were obtained for the Museum of the Royal gardens, of which the following is a selection.

Tamarinds, the fruits of *Tamarindus indica*, preserved in sugar. The tree is cultivated in all tropical countries, but it is from the West Indian islands and India that the European markets are principally supplied.

Candle Nut Oil (*Aleurites moluccana*).—This plant is widely distributed in tropical countries. The seeds contain a large quantity of oil, which is obtained by expression, and because of its drying properties is used for mixing with paints under the name of Country Walnut oil. The kernels when dried and stuck upon a stick are used as candles in the Polynesian islands.

Dilo Nut Oil (*Calophyllum inophyllum*).—A moderate sized tree of India, Ceylon, Andaman Islands, the Malay Archipelago, Australia, and Polynesia. From the seeds is expressed a thick, dark, strong scented oil, which is used both for medicine and for burning.

Copra, the dried kernel of the cocoa-nut (*Cocos nucifera*).—This is the most generally useful of all the palms, not only on account of its wide distribution, being found in the low-lying coast lands of most tropical countries, as India, Ceylon, Malay Archipelago, Straits Settlements, the Islands of the Pacific, West Indies, &c., but also for the numerous uses to which the fruits, fibre, &c. are put.

A considerable amount of attention has been given within the last 10 years to the cultivation of the cocoa-nut palm in the South Sea Islands, and a number of large plantations have been made.

The following notes are from the "Handbook to Fiji," issued in connexion with the Colonial and Indian Exhibition of last year:—"A "cocoa-nut has been known to flower in about four years, and others "at longer periods, but a fair crop of fruit need not be expected before "the tenth or twelfth year, after which the yield increases steadily "for five or six years more, when the maximum should be arrived at; "it then continues bearing heavy crops for 50 and even 60 years."

"Taking the produce of Fiji at 60 nuts per tree per year, an acre "would give, say, 4,200 nuts. This would make about two-thirds of a "ton of Copra, the average value of which is about 7*l.* 10*s.*, from "which deduct the expense of collecting and manufacture, which is

" about 2*l.* 10*s.*, which leaves a profit of 5*l.* per acre. It may be added " that Copra is shipped to Europe, where it sells at from 16*l.* to 20*l.* " per ton.

As regards the husk fibre, it is stated that the bulk of the fibre prepared in Fiji has hitherto found a market in Australia and New Zealand, but as the production increases it will be sent to other countries. "The husks from 7,000 cocoa-nuts produce about one ton " of fibre, which is of the value on the estate in Fiji of from 5*l.* to 15*l.* " per ton, according to quality. Brush fibre or bristles is worth from " 15*l.* to 30*l.* per ton, and yarn from 20*l.* to 30*l.* per ton in Fiji. The " cost of labour to produce one ton of fibre, exclusive of cost and wear " of machinery, may be put down at from 5*l.* to 10*l.*"

Besides the three principal articles of commerce obtained from the cocoa-nut palm, copra, cocoa-nut oil, and coir, the kernel of the nut is eaten in large quantities when young and fresh, and the hard, bony shell is made into drinking vessels, and other useful and ornamental articles. It is estimated in Fiji, where the cocoa-nut thrives so luxuriantly that it will, ere long, compete with sugar, tea, and coffee, as a source of great wealth to the colony.

Kava root (*Piper methysticum*).—The finest masses of this root shown at the Exhibition were afterwards obtained for the Museum collection, together with a sample of the ground root. Kava root is the source from whence the Fijian beverage called Kava is made, in former times by masticating the root, ejecting the saliva into bowls and fermenting it. The root is known to have diuretic properties, and has attracted some attention in this country of late for its medicinal value. During the period of the Exhibition a spirit was prepared from Kava root under the name of yagona, Kava schnapps, or aromatic gin, and sold at the refreshment bars. It was described as "having been the Royal drink of the Fijian and Samoan Chiefs from time immemorial."

Bandina Boxwood.—The botanical source of this wood cannot be traced, nothing but specimens of the wood itself, prepared in square blocks and smoothed ready for engraving purposes, having been received. The wood is of a very dark reddish brown colour, close and even-grained, and apparently very dense, and from outward appearances it would seem to be a good substitute for boxwood. Upon submitting a sample to Mr. Robson J. Scott, the well-known boxwood block manufacturer, of 8, Whitefriars Street, E.C., for his opinion, I was favoured with the following, dated 17th June 1886:—" I think your " Fiji wood has no special claim for engraving purposes, its colour is " bad and reduces its value. It would be only fit for common work, " for which nature supplies us with a sufficient quantity of inferior " box." In a further communication, dated 21st June 1886, Mr. Scott says:—" Another word upon this wood. Cutting upon wood is " like drawing upon paper, if it is tinted there must be a limit to the " density of the tint, or your drawing will be absorbed by the tint upon " which it is drawn. An engraver would have difficulty in observing " his progress while doing his work."

Notwithstanding this unfavourable report as to its use for engraving purposes, the wood might become useful where a very hard, dense, and high coloured wood is desirable. It is said that if a demand should arise for it a large supply could be had from Fiji and the other outlying groups of islands in the Pacific, and the wood could be had of a size up to two feet in diameter.

The collection of Fijian timbers presented to Kew have been arranged in Museum No. 3, and a description of them will be incorporated in the next edition of the Guide to that Museum.

CAPE OF GOOD HOPE.

A large and varied collection of vegetable products were obtained for the Museum from this Commission, including some fifty-five specimens of drugs and forty specimens of woods. Amongst the former the following may be enumerated :—

Groot Bells (*Osmitopsis asteriscoides*).—The plant is found along the banks of streams. It has a strong aromatic odour and taste, and is used in the form of an infusion in coughs, hoarseness, and chest diseases generally, as well as in flatulence. The plant abounds in an essential oil, which is said to have a peculiar affinity to cajeput oil.

Bok Buchu (*Agathosma virgata*). — The plant grows on the mountain slopes, and is used for pulmonary complaints.

Wild Celery (*Bubon Galbanum*).—It is found all over the Colony in moist situations or in ravines of mountains, and has an acknowledged reputation amongst the people as a diuretic. A decoction of the leaves is used in dropsy and gravel.

Wild Dagga (*Leonotis Leonurus*).—It grows wild in the Sandy Cape flats, and often on the roadsides, but is often grown in gardens on account of its beautiful flowers. It has a peculiar scent and a nauseous taste, and produces narcotic effects if incautiously used. In the form of decoction it is employed in chronic cutaneous eruptions. "The " Hottentots are particularly fond of this plant, and smoke it instead " of tobacco, and take a decoction of its leaves as a strong purgative. " The Kafir name of the plant Umfinca-fin-cane is taken from the " sugar birds sipping the sweets from the bottom of its long trumpet- " shaped corolla. Before the mouth of its corolla opens, which it does " when the stamens are mature, the nectar is intensely bitter, but at the " moment of opening the sweetness is developed."

Sour Figs (*Mesembryanthemum edule*).—"Few South African " plants are so much in domestic use as this species and *Mesembryan-* " *themum acinaciforme*, both of which are common in the sandy tracts " of the Colony. They are astringent and sourish in taste on account of " the acidulated alkaline salt with which they seem to be impregnated. " The expressed juice of the succulent leaves taken internally checks " dysentery and acts as a mild diuretic, while it is also, for its antiseptic " property, used as an excellent gargle in malignant sore throat, violent " salivation and aphthæ, or in the form of a lotion in burns and scalds. " At the Cape these plants are called Hottentots vijgen or Hottentots " figs. The fruit is eatable and used for preserves."

Xaibosch (*Helichrysum serpyllifolium*).—A composite plant growing near the watercourses on the Cape mountains ; it has a pleasant smell, and is much liked by the coloured people, who use it as tea, hence it is known as Hottentots tea. It possesses demulcent and emollient properties, and is used in catarrh as well as in diseases of the chest.

Wilde Als or **Wormwood** (*Artemisia Afra*).—"The whole plant has " a strong balmy smell, and a bitter, aromatic, but nauseous taste owing " to a green essential oil which it contains. The herb is tonic, anti- " spasmodic and anthelmentic, and very useful in debility of the " stomach, visceral obstructions, jaundice, hypochondriasis, or similar " evils, while its efficacy as a vermifuge is generally admitted. The " best forms for using it are the infusion, the decoction, and tincture,

" the latter being preferred by the colonists. A strong infusion is used " externally as a collyrium in weakness of the eyes, and the pounded " leaves and stalk are employed as a discutient in œdema and suggil- " lations."

The following are some of the most important Cape woods received :—

Stinkwood or **Laurel Wood** (*Ocotea* [*Oreodaphne*] *bullata*).—A tree 50 to 60 feet high, and a diameter of from 4 to 5 feet. The tree rarely grows upright from the fact, it is alleged, "that most of the " trees are produced from coppice shoots. The stinkwood seedling is " endowed with a hardy constitution, but when it reaches the ligneous " state it requires plenty of air, and to participate freely in the various " atmospheric influences—light, dew, rain, &c. It cannot stand dense " shade for any length of time. It is reproduced by a process of natural " coppicing, which is extremely curious. The trunk of an old tree dies " from the top downwards, and then from the base is produced a sheaf " of young shoots round the old dead trunk. These dead logs remain " standing a long time before decaying, and frequently yield good, " sound timber. If the old trunk be not removed and suffered to decay, " the young shoots put out roots which run down the parent trunk, " eventually reaching the ground, where they take root. Young trees " in this manner are very liable to become windfalls."

Three varieties of stinkwood are known at the Cape, white, mottled, and nearly black; these are said to be due probably to varying conditions of growth rather than to any botanical differences.

From the specimens exhibited in the Museum it will be seen that the wood is not unlike walnut, and that it takes an excellent polish. Mr. Ransome in his Report on Colonial Timbers says, "the wood proved " easy to work in all cases, and left the cutters with a good finish."

Yellow Wood or **Upright Yellow Wood** (*Podocarpus latifolius*).—The tree grows under favourable circumstances to a height of 75 feet, with a diameter of 2 feet, and forms a remarkably straight trunk. It grows readily from seed, and small trees are abundant in the forest. The tree is felled in the Amatolas during the months of May, June, and July, and then left to season for a year in a place sheltered from sun, rain, and hot winds. Unless cut in the proper season and carefully dried, it warps and splits badly.

The wood is of a light yellow colour, fine and close grained, and according to Mr. Ransome's report proved very easy to work. "It was " passed through the vertical frame, and was found to saw very clean " with a rapid feed. It was passed through the planing and moulding " machines with a feed of 40 feet a minute, leaving a fine and very " smooth surface." For bedroom furniture the wood is excellent, and was much admired at the Exhibition. The tree is abundant in the forests of George, Knysna, and Amatola.

Outeniqua Yellow Wood (*Podocarpus elongatus*).—This is a much larger tree than the preceding species, attaining indeed a larger size than any other tree in the Colony. Notwithstanding that this wood has been used in very large quantities in the Colony for beams, planks, flooring boards, and similar purposes, "there still remains gigantic " specimens of these beautiful and stately trees in the forests of Knysna " and Alexandria, on the coast, and in the Amatola mountains. Bush " cutters have preferred to fell the smaller and more easily handled " timber rather than encounter the labour and difficulty of sawing and " shipping these monsters. . . . One of the largest trees measured " at Knysna is 23 feet in circumference and 80 feet in height. In the

" Amatolas trees of this size are more common. The largest tree " measured there has a girth of 34 feet, and is 90 feet high."

The wood, when well selected and properly seasoned, should be of a light yellow colour and a straight even grain. The slab presented to the Kew Museum, measuring 20 feet long and 5 feet in diameter, shows a dark centre and some cracks, indicating that proper care was not taken in its seasoning.

Black Iron Wood (*Olea laurifolia*).—An erect tree, 40 to 70 feet high and 2 to 3 feet in diameter, abundant in the Knysna forests and in the Amatolas. The sapwood is white, while the heartwood is of a dark brown with black wavy markings, similar to, but much darker than common olive wood. "Decay frequently begins between the heartwood " and sapwood, and gradually extends outward until nothing but the " heartwood remains," which is well nigh imperishable and is said to equal lignum vitæ in durability. The wood makes excellent furniture, but owing to its hardness it is difficult to work. It is much used for the framework of waggons.

Amongst other Cape woods presented to the Museum which appear to be worth the attention of the cabinet-maker are the following:—

Cape Ash (*Ekebergia capensis*).—Tree 40 to 50 feet high; 2 to 3 feet diam.

White Iron Wood (*Toddalia* [*Vepris*] *lanceolata*).—Tree averaging 20 feet, but sometimes 60 feet high; 1 to 4 feet diam.

Saffron Wood (*Elæodendron croceum*).—Tree 20 to 40 or even 60 feet high, and 2 to 4 feet diam.

The bark is used for tanning and dyeing.

White Pear (*Pterocelastrus rostratus*).—Tree 20 to 30 or sometimes 70 feet high; 1 to 2 feet diam.

Cape Beech or Benkenwood (*Myrsine melanophleos*).—Tree 20 to 25 feet high; 12 to 18 inches diam.

Red Els or Red Cedar (*Cunonia capensis*).—Tree 15 to 25 or even 60 feet high; 2 to 3 feet diam.

White Alder (*Platylophus trifoliatus*).—Tree 30 to 40 feet high; 2 to 4 feet diam.

Red Pear (*Scolopia* [*Phoberos*] *Ecklonii*).—Tree 30 to 35 feet high; 2 to 3 feet diam.

Quar (*Euclea undulata*).—Tree 20 to 30 feet high; 12 to 15 inches diam.

Vlier (*Nuxia floribunda*).—Tree 20 to 25 feet high; 15 to 20 inches diam.

Red Wood or Cape Plane (*Ochna arborea*).—Tree 20 to 40 feet high; 12 to 18 inches diam.

Knobwood (*Xanthoxylon capense*).—Tree averaging 15 to 20 feet, but sometimes attaining 50 to 60 feet high; 1 to 2 feet diam.

Wild Chestnut (*Calodendron capense*).—Tree 60 to 70 feet high; 4 to 5 feet diam.

Keurboom (*Virgilia capensis*).—Tree 20 to 25 feet high; 12 to 18 inches diam.

The most remarkable, perhaps, of all the Cape woods is the **Umzumbit** or **Umtiza** (*Millettia caffra*). " A small but common tree of " the East London and Transkeian Coast forests. Attains a height of " 30 to 35 feet, and a diameter of $1\frac{1}{2}$ to 2 feet. Umzumbit is remarkable " for its deeply fluted stem, and very hard, well defined heartwood. The " most valuable Kafir walking sticks are made from this wood by " splitting a billet out of the centre of the tree, and then paring away all " but the knob to the thickness required. Clubs and amulets are also

" made from the wood in the Transkei. Owing to the small size of the " tree, and its curious habit of growth, it can only be used for small work ; " but the rich colouring of the strongly marked heartwood has a hand- " some appearance against the hard but light coloured sapwood. . . . " Umzumbit will probably be a valuable tree if the Transkeian forests are " systematically worked. It is believed to be the hardest and heaviest " wood in South Africa."

Reporting on this wood Mr. Ransome says :—" Being very hard, of a " somewhat greasy nature, and free from resin, Umzumbit is con- " sidered an excellent wood for bearings, the result of some experiments " with the diamond polishing machines at the Colonial and Indian " Exhibition showing that it will last nearly seven times as long as " Lignum vitæ."

NATAL.

The specimens obtained from this Colony were of a varied character, and interesting as showing the progress made since the International Exhibition of 1862, especially in the case of tea and maize. Some samples of tea of very good quality were obtained for the Museum ; and it is interesting to know that the China tea exhibited by Mr. Brickhill was procured from plants introduced from the Royal Gardens, Kew, 20 years ago.

In connexion with the tea industry in Natal the following extract from the Natal Official Handbook will be found useful :—" Tea is now " looked upon as one of the most promising industries of the coast. " A few plants were introduced in the early days of the Colony from " Kew, and seemed to do well. About 1863 some attention was given " to the subject, but from want of skill in management, the samples " produced did not find favour, and it was thought that the variety of " the plant was one which would not produce a good marketable article. " It was not till the apparent failure of the coffee tree showed that " something was wanted to take its place on small plantations that " efforts were made for the importation of fresh seed. This was " obtained through Calcutta in 1877, and the varieties imported were " Assam hybrid and Assam indigenous. Since then the tea enterprise " has made steady progress, and seems eminently adapted for small and " well-managed estates on the coast belt, and may possibly yet be found " profitable further up country. The experience gained, not without " cost and difficulty by the pioneers, is available for the benefit of the " Colony. The climate evidently favours the plant. The yield is " large, there is plenty of very suitable soil, and labour is not more " costly than in many tea countries. Though struggling against " local prejudice and custom, which still cling to China teas of intrin- " sically inferior quality, there are hopes that Natal tea may become an " important article of export as well as of local consumption. It " possesses fine flavour and strength, and promises to make its way on " its own merits in the London market. There are now 12 growers, " mostly in the Tugela division of Victoria county, and the total " acreage at present under tea is about 400 acres." About 200 additional acres were prepared during the past year. The yield per acre has been very large, amounting in three years to 200 lbs. of dry tea ; in four, to 400 lbs. ; in five, to 600 lbs. ; and in six to 800 lbs. Tea was exported from Natal in 1883 to the value of 1,499*l.*

Maize (*Zea Mays*).—This is described as by far the most important grain crop of the Colony, thriving everywhere, from the mountain tops

to the sea. It is the universal food of the natives, and furnishes the settler with a very large proportion of his every day fare. It grows well under the rudest preparation of the soil, and yet repays abundantly the outlay spent in thorough and careful cultivation. The grain is generally known under the name of mealies; about three million bushels being the quantity produced in the Colony in 1884. Last year's (1886) crop was so large that it was estimated that it would be considerably in excess of the home demand, and a channel for export would have to be sought.

Amongst tanning substances, of which many were exhibited, those of the greatest interest and the least known were the bark and root of **Intolwana** or **Elands Bontjes** (*Elephantorrhiza Burchellii*), which has attracted some attention of late in consequence of the high per-centage of tannin it is said to contain, and the Umgwenga bark (*Harpephyllum Caffrum*). The tree is known at the Cape as the **Kaffir Plum**, and the wood is useful for cabinet-work.

The following are amongst other specimens of less interest received from Natal :—

Ground Nut oil cake from *Arachio hypogæa*. **Wild tea**, from *Geranium incanum*. Concrete and crystallised **Sugar**, from the sugar-cane (*Saccharum officinarum*). **Linseed** (*Linum usitatissimum*). Extract of **American Aloe** (*Agave americana*), used in medicine. **Tobacco**, in leaf and cut. **Fenugreek**, the seeds of (*Trigonella Fœnum Græcum*), &c. &c.

CEYLON.

The exhibits from Ceylon were very numerous and very varied; specially prominent were the collections of woods and drugs. Neither of these, however, were available for the Museum of the Royal Gardens; nevertheless, a large number of specimens, including foods, drugs, oils, &c., were presented by the Commission, of which the following are some of the most important :—

Cardamoms, the fruits of *Elettaria Cardamomum*.—A perennial herb, native of Southern India, and growing abundantly in rich humid elevated forests in North Canara, Coorg, and Wynaad. The fruits are gathered and dried, and then form the Cardamoms of commerce, which are valued for their agreeable aromatic character, and their carminative and stimulant properties. Besides being used in medicine, they enter into the composition of curry powder.

Cinnamon (*Cinnamomum zeylanicum*).—Some fine bundles of this important and well known spice were exhibited. These bundles were remarkable for the smallness of the quills of which they were composed, as well as for their pale even colour and delicate flavour. One bundle was obtained for the Museum.

Vanilla.—The pod-like fruits of *Vanilla planifolia*, a climbing Orchidaceous plant, native of Mexico, where also now it is extensively cultivated, as well as in Mauritius, Bourbon, Madagascar, and Java. The pods after gathering are carefully dried by alternate exposure to the sun and air, and wrapping in woollen cloths sometimes steeped in oil. The vanilla of commerce is obtained from Mexico, Bourbon, Mauritius, Java, Honduras, Brazil, &c.

Areca Nuts (*Areca Catechu* var. *alba*).—These are the seeds of a graceful palm found throughout Peninsular India, Ceylon, South China, the Phillipines, and the islands of the Malay Archipelago. The Areca, or Betel Nut as it is mostly called, is usually about the size of

a nutmeg, but more spherical and flattened or depressed; they are marked throughout their substance with a brown rumination; they are astringent, and are largely used in the East as a masticatory. The actual specimens here referred to are of unusual size.

The following samples of Ceylon **Tea** were obtained for the Museum:—Flowery Pekoe, Pekoe, Broken Pekoe, and Pekoe Souchong. The tea industry in Ceylon has marvellously increased during the past 10 years. In 1876 only 282 lbs. were exported, while in 1885 the exportation had reached 3,796,684 lbs.

Cinchona barks were fully illustrated at the Exhibition, and the Museum of the Royal Gardens became enriched by specimens, each six feet long, of the following species:—*Cinchona succirubra*, renewed quill; *C. Ledgeriana*, original quill; *C. officinalis*, renewed quill.

A collection of 37 specimens of fruits, seeds, and drugs, new to the Museum, were also obtained from the Ceylon Commission.

MAURITIUS.

Besides the entire collections of fibres and woods exhibited in this court, several of which are of especial interest, the Museum received samples of remarkably fine **Vanilla** pods covered with crystals of vanilline, and of **Job's tears**, the seeds of *Coix Lachryma*, a common tropical grass, the seeds of which are much used for necklaces and other ornamental purposes.

STRAITS SETTLEMENTS.

The collection of vegetable products presented to the Kew Museums by the Commissioners for the Straits Settlements amounted to some 115 specimens, and included woods, barks, fruits, seeds, &c.

The following are among the most important or interesting:—

Grogoh, or trap used for catching river fish, made of a single stem of Bamboo by splitting, opening it out, and plaiting.

Damar holder, used as a candlestick. This is an instrument for holding a kind of torch made of resin of a species of *Shorea*.

Betel Nut Fibre (*Areca Catechu*).—This is the fibrous husk of the fruit exhibited as a paper material. As a waste product it is said to be produced in almost unlimited quantities. Considering the very general practice of Betel chewing in the East, and the abundance of fruits produced, the adaptation of this apparently useless material for paper making would seem to be a very probable benefit to the countries where the *Areca Catechu* is common.

Fine samples of the following edible fruits preserved either in syrup or spirit were also obtained:—

Dookoos (*Lansium domesticum*), **Rambutan** (*Nephelium lappaceum*), **Kepayang** (*Hodgsonia heteroclita*), **Buah Brangan** (*Castanopsis sp.*), *Peirardia sapida*, *Rhodomyrtus tomentosa*, **Papaw** (*Carica Papaya*), *Zalacca edulis*.

BRITISH NORTH BORNEO.

By far the most important of the vegetable products exhibited by this Commission, and which were at the close of the Exhibition presented to the Kew Museum, were the woods. Some very fine planks of the principal timbers attracted a good deal of attention during the period of

the Exhibition, and now form a feature in the timber collections at Kew. Many of these woods unfortunately had no scientific names, such, for instance, as the—

Billian or **Borneo Iron Wood.**—It is very hard and heavy, exceedingly strong and tough, "proving," Mr. Ransome says in his report, "more "than 50 per cent. stronger than English oak in resisting a breaking "strain. . . . It is proof against the teredo and white ant, and "is consequently in great demand for wharf piles and planks in the "Straits Settlements and China. This wood should be largely imported "into England, as it could be sold at the London Docks with a good "profit at 3*s.* 6*d.* a cubic foot, and might take the place of green-"heart and teak for many of the purposes for which those woods are "now employed."

Sumatra or Borneo Camphor Wood (*Dryobalanops aromatica*).—This wood is remarkable as being the source of the well known Sumatra Camphor, which is found crystallised, often in large masses, in interstices of the wood. It is not so volatile as ordinary camphor, and is harder and more brittle. The Chinese use it in preference to the camphor of commerce, which is a product of their own country. The wood is of a dark brown colour, hard, and heavy.

Mirabou (*Afzelia palembanica*).—This is a strong and durable wood, with a dark brownish figure. It somewhat resembles teak in grain, and is well adapted for furniture and cabinet work, as it works well and takes a good polish.

The other woods received at Kew are—

Penagah, White Borneo Cedar, Greeting, and **Russock.** All of them are woods of more or less value. Besides these, various samples of **Gutta-percha,** and some remarkably fine specimens of Dipterocarpeous **Resins,** were presented to Kew by the British North Borneo Company.

BRITISH GUIANA.

The most striking exhibits obtained from this Colony were the two magnificent squared trunks, most liberally purchased and presented to the Royal Gardens by Everard im Thurn, Esq., Stipendiary Magistrate, Pomeroon river, of **Greenheart** (*Nectandra Rodiæi*), and **Mora** (*Dimorphandra* [*Mora*] *excelsa*). The first is one of the tallest of forest trees of British Guiana, logs being obtainable from 18 to 24 inches square and 70 feet long. Greenheart is one of the most durable woods known. It is used for keels and other timbers of vessels, house framing, mill timbers, wharves, &c., and the bark is the source of the well known alkaloid *Beeberine*, used as a tonic and febrifuge. The Mora is also a very large tree, growing to a height of 200 feet and squaring 24 inches. The wood is extremely strong and durable, and is used for ship and house building, furniture, &c. The bark is astringent, and used in medicine and tanning. The two specimens here alluded to it will be remembered stood at the entrance to the British Guiana Court of the Colonial and Indian Exhibition, and measured some 28 feet in length.

Besides these two logs, the Museum is also indebted to Messrs. Park and Cunningham, of Georgetown, Demerara, for a set of 25 selected specimens of native woods. The other products obtained from this Court included **Dried Bananas** and **Plantains. Ochro seeds** (*Hibiscus esculentus*). Preserved **Tamarinds** (*Tamarindus indica*). Dried **Sorrel flowers** (*Hibiscus Sabdariffa* Seeds of *Ormosia dasycarpa*. **Rubber**

from *Hevea spruceana*. Dried **Sweet Cassava** in slices (*Manihot Aipi*). Ball and Sheet of prepared **Balata** from *Mimusops globosa*. Fruits of **Tonquin Bean** (*Dipteryx odorata*). Bark of *Simaruba amara*. Fibre of the Monkey Pot tree (*Lecythis ollaria*). Fibre of Arassee (*Corchorus siliquosus*), &c. &c.

JAMAICA.

From this Colony a collection of over 100 specimens were obtained, consisting of fruits preserved in fluid, seeds, barks, oils, &c. The following notes refer to a few of the most important.

Ylang Ylang, the fruits of *Artabotrys odoratissma*.—From the flowers of this plant the well known perfume known as Ylang Ylang is obtained.

Star Apple (*Chrysophyllum Cainito*).—The fruits are edible and a spirit is also distilled from them.

Jimbling (*Phyllanthus distichus*).—The fruits are acid and are used for pickling.

Arracacha, Tubers of *Arracacia esculenta* cultivated and eaten as a vegetable.

Carambola (*Averrhoa carambola*).—An acid edible fruit; used also for pickling.

Coco Plum (*Chrysobalanus Icaco*).—The fruits, which are about the size of an ordinary plum, have a sweetish taste, and are eaten either raw or made into preserve.

Bottle Cod root (*Capparis cynophallophora*).—Adrue roots (*Cyperus articulatus*). Pomegranate root bark (*Punica granatum*). Soap berries (*Sapindus inæqualis*). Guaco roots (*Mikania guaco*). Bastard cabbage bark (*Andira inermis*). Locust tree bark (*Hymenæa courbaril*). Roots of False Ipecacuanha (*Asclepias curassavica*). Balsam tree bark (*Amyris balsamifera*). Maiden Plum bark (*Comocladia integrifolia*). Also a collection of essential oils prepared from the following plants:—*Hedyosmum nutans*, *Eucalyptus Globulus*, *Critonea-dalea*, *Andropogon citratus*, *Juniperus bermudiana*, *Micromeria obovata*, *Pimenta officinalis*, *Moringa pterygosperma*, *Cocos nucifera*, *Aleurites molucana*, *Hura crepitans*, *Calophyllum calaba*, *Fevillea cordifolia*, *Citrus Bigaradia*.

TRINIDAD.

From this island came a collection of 35 specimens of native woods in planks, averaging in size 3 feet by 18 inches. These are for the most part well selected and prepared specimens, and have been arranged in Museum No. 3.

GRENADA.

A remarkably fine collection of fruits of this island, preserved in brine, were exhibited by Colonel Duncan. The whole of the collection was presented to the Kew Museum at the close of the exhibition; and comprised, amongst others, the following:—**Bread Fruit** (*Artocarpus incisa*). **Jack Fruit** (*A. integrifolia*). **Papaw** (*Carica Papaya*). **Sweet Potatoes** (*Ipomæa Batatas*). **Custard Apples** (*Anona reticulata*). **Kola Fruits** (*Cola acuminata*). **Cloves** (*Eugenia caryophyllata*). **Sand Box fruits** (*Hura crepitans*). **Pois doux** (*Inga-laurina*). **Nutmeg**

Fruits (*Myristica fragrans*). **Gru Gru** (*Acrocomia sclerocarpa*). *Lucuma mammosa*, *Achras Sapota*, &c. Many of these fruits were of exceptionally fine growth, and extremely well preserved.

DOMINICA.

Dr. H. A. Alford Nicholls, F.L.S., who was a very large exhibitor from this island, and who is a valued correspondent of the Royal Gardens, the Museum being indebted to him for many previous contributions, kindly placed the whole of his collection at the disposal of Kew. A large number of interesting specimens were thus secured, including the following :—**Guava** bark (*Psidium Guaiava*). Very fine pods of *Acacia Farnesiana*. Husks from seeds of **Liberian Coffee**; these are said to be worth from 1 to 2 cents per pound in the United States, where they are roasted and ground. **Angelin** bark (*Andira inermis*). Fine pods of **Purging Cassia** (*Cassia Fistula*). Hat stand made of **Swizzle stick** wood (*Myrodia turbinata*). **Carib ginger**, and a collection of Dominica woods.

From Bahamas, St. Lucia, Antigua, and Montserrat, specimens in smaller numbers were procured.

BRITISH HONDURAS.

In this court the Belize Estates and Produce Company were large exhibitors of vegetable produce, and through the courtesy of the secretary many valuable additions were made to the Museums, notably the following woods:—**Star Apple** (*Chrysophyllum Cainito*), **Madu Cacao** (*Erythrina umbrosa*), **Ironwood** (*Laplacea hæmatoxylon*), **India Rubber** (*Castilloa elastica*); a remarkable twisted specimen of **Logwood** (*Hæmatoxylon campechianum*), and a fine buttressed base of a **Mahogany** trunk (*Swietenia Mahagoni*).

WEST AFRICAN SETTLEMENTS.

The collections from Sierra Leone, Gambia, Gold Coast, and Lagos were of a very varied character, including a large number of raw vegetable products. Comparatively few, however, were absolutely new to the Kew Museum, and a large number were badly prepared or without names. Some very large balls of **rubber** were obtained from Sierra Leone, Gambia, and Gold Coast; also samples of **Indigo** in course of preparation from *Lonchocarpus cyanescens*, — **Laintlaintain Seeds** (*Lophira alata*) the oil of which is expressed and used both for cooking and for the hair. Seeds of *Hyptis spicigera*, an oil seed from Sierra Leone. A yoke for carrying loads made of the petiole of *Raphia vinifera*, and many other specimens.

CYPRUS.

The exhibits from this recent addition to the British possessions were not numerous. Vegetable products were poorly represented. The following are amongst the specimens obtained for the Museums:—Black

Honey prepared from **Carob** beans (*Ceratonia Siliqua*). These beans contain a large quantity of sweet pulp, and are used in Southern Europe for feeding horses, mules, pigs, &c., and even for human food in times of scarcity. Quantities of the beans are now imported into this country, and form one of the ingredients in the concentrated cattle foods. **Trimithia Seeds** and Gum (*Pistacia Terebinthus*), Wood and Cones of *Alnus orientalis*. Fruits of *Arbutus Andrachne*, &c.

INDIA.

The enormous collection of vegetable products shown in this court made the selection for the Kew Museum one of some difficulty, nevertheless a very large series was procured and removed to Kew. The following are only a few examples showing the nature of the exhibits.

Among the more important specimens of timber acquired for the Museum may be mentioned a fine slab of **Padouk** or Andaman Redwood (*Pterocarpus indicus*), a lofty tree of Burma and the Andaman Islands. The wood is fairly hard, of a deep red colour, which darkens or becomes brown on exposure to the light ; it seasons well, and takes a good polish, for which reasons it is much used for furniture as well as for cabinet work, &c.

Andaman Marble Wood (*Diospyros Kurzii*) is produced by an evergreen tree, native of the Andaman Islands, as its common name indicates. This wood was an interesting feature in the Indian Economic Court on account of the peculiar marking of one slab, which resembled as nearly as possible what might be effected by the casual upsetting of an ink bottle, an appearance not to be found in any other wood. The wood is very hard, and is usually irregularly blotched with black markings upon a greyish ground, arranged in alternate streaks of grey and black ; it is used in cabinet work, and should be better known to English hardwood dealers. The Andamanese employ it for handles and sheaths of blades, and for furniture.

A dug-out or canoe formed from the hollowed out stem of the Tál or **Palmyra Tree** (*Borassus flabelliformis*), was secured for and has been placed in the No. 2 Museum. The Hindoos also use the hollowed out stems of this palm for water pipes ; and split in half for gutters and open water channels.

The highly interesting and instructive model of an **Indigo factory**, which has now been placed in a special case in Museum No. 3, was an object of particular attention during the Exhibition ; it shows the manufacture of indigo through all the various processes, from the bringing in or harvesting of the crop to the finished manufactured product.

Another model showing the **collection of Toddy**, from the Indian Date Palm (*Phœnix sylvestris*), and its subsequent conversion into sugar, has been placed in the No. 2 Museum. The collector of the toddy is represented in the crown of leaves, drawing the juice from the freshly cut spathe.

A very large collection of fibres was sent from India to the Exhibition, and from these a typical set was selected for Kew. Among the more important of them may be mentioned the following :—

Jute (*Corchorus capsularis, and C. olitorius*). The former species yields the Jute fibre of Central and East Bengal, while the latter is that

cultivated in the vicinity of Calcutta. Jute is an article of large and increasing importation to Great Britain, being chiefly used in the manufacture of carpets and other fabrics. The people of India use a large quantity of this fibre annually for agricultural and internal trade purposes, added to which an immense number of gunny bags leave India filled with sugar, wheat, rice, and other grains.

Sunn Hemp (*Crotalaria juncea*). This plant is extensively cultivated in India for its fibre, which by careful preparation becomes soft, fine, and white, bearing comparison with flax. The waste is utilised in the manufactnre of paper.

Deccani Hemp (*Hibiscus cannabinus*). A small shrub with prickly stems, generally cultivated in India; apparently wild east of the Northern Ghauts. The fibre produced from this plant is considered stronger, though not so good as the Sunn Hemp. In India it is used for nets and ropes, and in the Dacca district, Bengal, it is the chief fibre used in the manufacture of paper. It is also stated to be sometimes met with as an adulterant of jute.

Bauhinia Vahlii, an enormous and perhaps the most gigantic of the climbing plants of the Indian forests. Its uses are almost more numerous than those of any other forest plant except the bamboo. The bark is made into strong cordage, which is used for suspension bridges, and the fibre has been employed as a material for paper-making. The large flat leaves are sewn together, and used as plates, cups, umbrellas, and rain-caps. The pods are roasted, and the seeds eaten.

Coco nut (*Cocos nucifera*). The valuable coir fibre of commerce is obtained from the fibrous pericarp. A fibre is also prepared from the leaf stalks, but compared to the coir it is unimportant. Coir is very largely used in the manufacture of mats and matting. The net of fibres at the base of the petioles is made into bags and paper, and is also used in Ceylon for straining toddy.

Udal (*Sterculia villosa*), a moderate sized tree, common in the forests throughout India and Burma. The tree is so highly valued for its fibre, that in the more accessible forests, it may be said to occur chiefly as a bush from its branches being constantly lopped for the fibre they contain. The fibre is coarse but strong, and is made into ropes and coarse bags, and in Bengal, Burma, and South India, into ropes and breastbands for dragging timber.

Opium.—A cake of Benares Abkári or Excise Opium was obtained for the Museum. It consists of opium produced in the Benares Agency, which is exposed to the sun in shallow wooden trays until it has gradually become inspissated to such a consistence that 100 grains when dried on the steam-table at 200° Fahrenheit yield 90 grains at least of solid matter. The opium at this consistence is mixed up and trampled into a homogeneous mass, which is cut into portions of 2 lb. 0·914 oz. weight, and moulded into cakes in a hand-press, and stamped with the device of an Imperial crown and the words "Benares Opium." The cakes are then wrapped in two folds of Nepal paper (prepared from bamboo), the inner paper being smeared with a few drops of poppy oil to prevent adhesion. This form of opium is consumed either as a decoction or as prepared into madak or chandu for smoking in an opium pipe.

Of **Sugars** a few samples were selected from the exhibit of Messrs. Carew and Co.

Among the **Fruits** that of the Apricot (*Prunus Armeniaca*) deserves special mention, as there seems no reason why it should not, in a dried state, become an article of export to this country. In the North of India it is generally cultivated, and is naturalised in Afghánistán, Kashmír, and Chumba, in which countries the fruit is largely eaten by all classes, either when fresh or dried. From the kernels an oil is expressed which is used for burning in lamps,) for culinary purposes, and for the hair. In Damascus the stones are removed from the fruits and the pulp rolled out into thin sheets, in which form it is sold as food in the bazaars.

Another important article of food of the aboriginal tribes is afforded in the fleshy flowers or corollas of the **Mahwa** or Mahuá Tree (*Bassia latifolia*), a large deciduous tree common in the forests of Central India, and cultivated and self-sown throughout India generally. It is described as the most generally useful tree of the regions where it occurs. Mahwa flowers are also used as food for cattle, and are considered to be very fattening, for which purpose they are now exported to Europe. A good spirit is also distilled from them, and they also afford sugar.

Of a large collection of dyes, tans, &c., specimens of the undermentioned were among the more important selected :—

Safflower (*Carthamus tinctorius*).—An herbaceous plant with large yellow flower-heads, cultivated as a dye crop all over India. The flowers afford both a red and a yellow dye. At one time the cultivation of safflower in Bengal was one of the most important industries, but the introduction of aniline dyes has almost entirely ruined the trade. The seed, known as Kurdee, is an important oil seed of India.

Bengal Kino Tree (*Butea frondosa*).—A deciduous tree well known in India from its handsome, bright, orange-red flowers, which appear before the leaves in the hot season. The dried flowers known as "pulas" or "tesu," give a yellow dye which is extracted by simply boiling in water. The gum from this tree is sold under the name of Bengal Kino, and has the same properties as that obtained from *Pterocarpus Marsupium*; it is said to be used to purify indigo. The tree possesses valuable medicinal properties.

Catechu, Cutch, or Káth (*Acacia Catechu*). A common tree in most parts of India and Burma, attaining a height of from 30 to 40 feet. It yields a valuable extract similar to Gambir (*Uncaria gambier*) obtained by boiling down chips of the heartwood; it is used largely for dyeing and tanning, by calico printers to produce metallic shades, and also as an astringent in medicine. The value of the catechu exported from India during 1884–85 and the preceding four years was as follows :—1880–81, Rs. 42,66,415; 1881–82, Rs. 25,30,840; 1882–83, Rs. 30,52,434; 1883–84, Rs. 35,32,000; 1884–85, Rs. 28,20,785. The bulk of these exports consisted of Burma or Pegu cutch, but Bombay and the north-west provinces also export a considerable amount, the cutch of the latter being more particularly interesting, since it is of a different nature; it is of a paler colour than Burma cutch, and is baked into large cubes resembling Gambir. Instead of being boiled down to a thick extract, and then cast into large masses, twigs are placed in the concentrated decoction and the Kath allowed to crystallize. The substance thus obtained is afterwards thrown into cubes about 1½ inches in size.

The result of this mode of preparation is the production of a much purer article, and this or gambir is the form of catechuic acid eaten in pán by the natives of India.

From the foregoing notes it will be seen that from several of the British Colonies represented at the late Colonial and Indian Exhibition no specimens were obtained for the Kew Museum. This, in the case of South Australia, St. Helena, Ascension, Malta, Hong Kong, and the Falkland Islands, is due to the fact that none of the exhibits were required for the Museum.

With regard to Queensland and New Zealand the collections of woods from both Colonies were very perfect, especially those of Queensland. Many of them would have been very desirable additions to the Kew collections, the specimens already in our possession of woods from the former colony being very unsatisfactory representatives of its timber resources; but though frequent applications were made to the Executive Commissioners for both Colonies, the result in each case was unsuccessful.

J. R. J.

ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 10.] OCTOBER. [1887.

XIX.—ONION DISEASE AT BERMUDA.

(*Peronospora Schleideniana*, De Bary.)

The current *Bulletin* is occupied with the results of an inquiry conducted under the auspices of the Royal Gardens, into a disease prevalent at the Bermudas affecting the onion crop, which is a staple industry of these small islands. Owing to climate and geographical position these islands are enabled to raise large quantities of early vegetables, which are shipped and sold at New York at a time when the corresponding American produce has as yet scarcely shown itself above ground. The onion crop, amongst others, raised from seed obtained from Teneriffe, has hitherto proved most productive; but owing to causes which are discussed in the following pages, this crop has latterly proved less remunerative. An inquiry was desired in the interest of cultivators, and this inquiry was undertaken by Mr. Arthur Shipley, B.A., Fellow of Christ's College, Cambridge. Mr. Shipley's reports deal with the circumstances connected with raising and harvesting of onion seed at Teneriffe, and with an exhaustive inquiry carried on at Bermuda, while the usual crop of onions was being raised for the American market. The results of the inquiry are given with great clearness by Mr. Shipley, and remedial and other measures are suggested which deserve the attention which no doubt they will receive from the persons directly interested.

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1887.

Price Twopence.

From Governor and Commander-in-Chief of Bermuda to the Director, Royal Gardens, Kew.

Government House,
Mount Langton, Bermuda,
July 1, 1886.

Sir,

The Legislature of this Colony have voted a sum of money for the purpose of securing the services for a short time of an agricultural chemist, or other qualified person, to inquire and examine into the causes of the onion disease which exists in these islands, and to suggest a remedy.

It is believed that the cause is a small fly, which attacks the leaf and prevents in many cases the formation of the bulb.

It is impossible, so far, to say whether this particular fly is imported in the seed from Teneriffe (whence nearly all the seed is imported), or whether it is bred on the spot. The idea which finds favour with the Board of Agriculture here, is to send a qualified person to Teneriffe to examine and report on the method of raising seed, and whether there is, or has been, any failure of crop from disease or otherwise, and subsequently, for the same person to visit Bermuda during the growth of the onion crop (which is the staple crop of the island), and continue his researches on the spot.

I shall feel greatly obliged if you can recommend a gentleman to this service, and will state what annual salary he will require, which of course will be in addition to his actual travelling expenses.

Believe me, &c.,
T. L. J. Gallwey,
Governor and Commander-in-Chief.

From Royal Gardens, Kew, to Colonial Office.

Sir,

August 12, 1886.

I have the honour to enclose a copy of a letter which I have received from the Governor of Bermuda, respecting the mission of a qualified person to that Colony, and to Teneriffe, for the purpose of inquiring into the failure of the onion crop in the former island.

As the culture of this vegetable is one of the principal industries of the Colony, I regard the steps taken by the Legislature as judicious.

After some inquiry I have ascertained that Mr. Arthur E. Shipley, Demonstrator of Comparative Anatomy in the University of Cambridge, is willing to undertake the mission, and is well qualified for it.

His official duties at Cambridge require his presence there after October. The present appears to be the proper time to investigate the circumstances of the harvesting of the onion seed in Teneriffe. Mr. Shipley is willing to go at once to that island; and I am of opinion that that is the best course that can be taken.

I am, &c.,
W. T. Thiselton Dyer.

E. Wingfield, Esq.,
Colonial Office.

From Colonial Office to Royal Gardens, Kew.

Downing Street,
14th August 1886.

Sir,

In reply to your letter of the 12th instant I am directed by Mr. Secretary Stanhope to request you to inform Mr. Arthur Shipley

that he will be obliged to him if he will at once proceed to Teneriffe to investigate the circumstances of the harvesting of the onion seed there, with a view to his subsequently visiting Bermuda to inquire into and report upon the failure of the onion crop in that Colony.

A copy of your letter will be transmitted to the Governor of Bermuda.

I am, &c.,

EDWARD WINGFIELD.

REPORT by MR. ARTHUR SHIPLEY on the ONION CROP in the CANARY ISLANDS.

Having been requested by Mr. Secretary Stanhope to proceed to Teneriffe to investigate the circumstances of the harvesting of the onion seed there, I left England on the 20th August 1886, and proceeded to Teneriffe viâ Madeira. I landed at Santa Cruz on the 28th of August. I spent a week in this town making inquiries and interviewing the principal onion growers in the south end of the island; I then crossed over to Grand Canary, and having spent a few days there returned to Teneriffe and spent a fortnight at Orotava on the north side of the island; amongst other places I visited Tejina and spent some time with the onion farmer who supplies a great part of the seed of the red variety of onion for export. I left Santa Cruz for England on the 27th of September, and landed at Plymouth on the 2nd of October.

I am much indebted for information and assistance to the following gentlemen:—Her Majesty's Consul Mr. Dupuis, Mr. Charles and Mr. Hugh Hamilton; Dr. Victor Perez and Mr. George Perez; Mr. Reid, Her Majesty's Vice-Consul at Orotava; and to Herr Wildpret, Curator of the Botanical Gardens at Orotava; and Mr. Mackay, United States Consul at Santa Cruz.

Varieties of onions.

There are two varieties of onion grown in the Canary Islands, the white and the red. These varieties are not permanent, but pass into one another under altered conditions of the soil, &c. The white variety is chiefly grown in the Island of Palma and on the south side of Teneriffe, in the neighbourhood of Santa Cruz. Those grown in Teneriffe gradually lose their character, become reddish in colour, and after three years cultivation are indistinguishable from the red variety. Those, however, grown in the island of Palma maintain their character unchanged, hence the seed for export is obtained from the latter island. The red variety is grown on the north side of Teneriffe, chiefly in the neighbourhood of Tejina.

Method of cultivation.

The onions are grown from seed which is scattered by hand during the month of October. The seedlings are transplanted into new beds in the month of December. Before placing in the earth the end of the leaves is cut off for about one or two inches. The young plants are planted in rows at intervals of about eight inches. The harvesting of the onions commences about the 10th of April and continues through the latter part of April and May. The white variety comes into the market a little earlier than the red, and hence commands a better price. When gathered, the onions are left lying on the land for three or four days to dry in the sun; they are then strung into ropes, and so prepared for sale. Only one crop a year is obtained.

Soil

The soil is very light, and the ploughing very shallow. The fields are prepared by clearing a piece of waste of rocks, stones, &c., and then spreading a thin layer of earth on the floor of volcanic rock,

pumice stone, &c.; these are very porous, hence the plantations are particularly well drained.

Manure. As a rule only farm-yard manure is used, but in rare cases Peruvian guano; and a special kind of manure first prepared for the Cochineal plantations and known as Cactus guano, is employed with very good results in some parts of the island.

Irrigation. The young plants require frequent irrigation, the seedling before transplanting being well soaked eight or ten times.

Rotation of crops. The strain of onions is preserved from deterioration by alternating the onion crop with Indian corn, or more usually with potatoes, or by planting the onions in newly cleared ground. Thus the same field does not bear onions in two successive years.

Seed crop. Some of the bulbs from each crop of onions are set aside for the production of seed. These bulbs are replanted sometime during November in furrows about one foot wide, and at a distance of about 12 inches or 14 inches apart from one another. This distance is greater than exists between the onions grown for the bulb, which are planted too near one another to produce good "heads." Before planting the bulbs for seed, the top of each bulb is sliced off: by this means the number of heads arising from each bulb is increased; sometimes as many as 10 heads will grow from one bulb. The young heads begin to appear above ground about 14 days after planting. The heads ripen during the end of June and the first half of July, and as each head matures it is picked; the onion grower goes over the field every day and picks out the ripe ones. The heads are then spread on sheets and dried in the sun, and the seed is separated by rubbing with the hand.

About 1 lb. of seed is produced from every 20 onions, but the red seed is slightly heavier than the white. [All the growers were of opinion that the seed for planting in the autumn must be gathered in the summer of the same year, and that last year's seed will not germinate.]*

Method of packing the seed, &c. The seed for export to the Bermudas is packed in air-tight tins which are soldered down. These are shipped towards the end of July, viâ Liverpool and New York. Great pains are taken to ensure that the seed is new, though as no difference can be detected between new and old seed, the merchants are largely dependent on the honesty of the cultivators not to mix the seed.

Amount of seed shipped, prices, &c. There has been no falling off in the amount of onion seed exported from the islands in the last few years. The amount shipped during the last three years is roughly as follows:—

1884 - -	1,600 lbs. white seed.	3,300 lbs. red seed.
1885 - -	2,250 „ „	4,200 „ „
1886 - -	2,450 „ „	4,000 „ „

It will be noticed that the amount of red seed shipped is almost double the amount of white.

The prices are about 3*s.* per lb. for the white, and 1*s.* 6*d.* per lb. for the red seed.

By far the largest amount of seed exported is sent to the Bermudas, though a small but steadily increasing amount is supplied to the United States; and it is worthy of remark that the merchant who ships this, Mr. Mackay, United States Consul at Santa Cruz, has received no

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* In Vilmorin Andrieux's standard work, "The Vegetable Garden," it is stated that onion seed does not lose its germinating power for two years.

complaint as to any failure of crops from his correspondents in America, although the crops in Bermuda raised from the same seed are reported to be very defective.

Prices of onions.

The shipping prices for the onions themselves this year (1886) were from 3*s.* to 4*s.* 6*d.* a quintal (100 lbs.) for the white, and 2*s.* 6*d.* to 4*s.* a quintal for the red. The white variety comes into the market rather earlier than the red and thus commands a rather higher price.

Diseases or other causes of failure in the onion crop.

The onions grown in the Canary Islands suffer from two distinct diseases, in addition to which sometimes the plants wither after being transplanted; this seems to be caused either by unfavourable atmospheric conditions at the time of planting or by the plant failing to strike root.

Hitherto none of these have caused any failure in the crop or given rise to much anxiety amongst the cultivators. The loss has never exceeded 20 per cent., and that is very exceptional.

I. La Escarcha or La Ceniza.

The disease which is called in the islands La Escarcha (hoar frost) or La Ceniza (ashes), takes the form of a light powder which is found on the leaves of the affected plant. At its first appearance the powder is of a light ashy colour, but as the disease increases it becomes darker, and if the plant is severely attacked, quite black, giving a velvety appearance to the leaf. The powder occurs all over the leaf and on all the leaves of an attacked plant. Some cultivators say that it does not occur uniformly throughout the plantation, but only in patches here and there, others say that the whole crop is affected, but in some places much more intensely than in others.

The disease attacks plants on all kinds of land, and hence it is difficult to avoid, but it is not feared so much as the second disease—the Quesillo—because it does not rot or destroy the bulb, but only arrests its growth. The onions remain small, but can still be used. Since the growth of the plant is arrested no head is produced, and the plant gives no seed. The disease attacks both red and white varieties of onions indifferently, but the former resist it slightly better.

The most favourable atmospheric conditions for the development of this disease is when a heavy dew falls after a long period of drought. The powder then makes its appearance on the leaves. A heavy shower, or artificial watering, or, in some cases, a high wind will sometimes cleanse them; hence well-sheltered plantations are favourable to the progress of the disease.

It is highly probable that this disease is caused by a fungus; it is often spoken of in the islands as the Onion Oidium, in some parts it is usual to dust the leaves with flowers of sulphur, and generally the same means are taken to arrest its progress as prove efficacious with the *Oidium Tuckeri* of the vine.

It is worth notice that plantations near the sea never suffer, except perhaps a few plants growing close under a wall.

II. El quesillo.

This disease is more feared than the foregoing, because it not only arrests the growth of the plant, but it rots and destroys the bulb itself. It usually makes its appearance when the bulbs have already attained a large size; and it commences by a blackening and subsequent rotting of the roots.

The parts of the plant above ground show but very slight signs of being affected; at most the leaves begin to lose colour, their tips especially becoming paler; so that as a rule it is not until the plants are gathered that the disease is first noticed. Then it is seen that the roots and usually the outer leaves of the bulb are black and rotten.

The bulb inside is sound, but if the outer layer of leaves is removed the next layer becomes affected.

It is impossible to make any use of the onions attacked by Quesillo, as they cannot be strung into ropes, since the leaves become rotten after the plant is gathered.

This disease occurs chiefly in damp places, especially in heavy clayey soils, but if the ground is carefully chosen, well worked and drained, there is no cause to fear it. In a plantation it usually occurs in patches, such patches corresponding with the dampest parts of the field.

Nothing is definitely known as to the nature of this disease, but all the symptoms point to the conclusion that it is caused by a fungus.

Another form of evil which injures the onion crop, affects the young plants a day or two after they have been transplanted in December. The leaves begin to fade and fall back in themselves, becoming at the same time whitish in colour, and the plant ceases to grow. Since this takes place quite at the beginning of the cultivation, it is easily repaired by pulling up the faded plants and replacing them by healthy ones.

This fading is probably to be attributed either to unfavourable weather at the time of transplanting or to the young plants failing to strike root.

Absence of insect injuries.

There appears to be no trace in the Canary Islands of any insect injury to the onion crop, such as is common in the English onion fields. I interviewed many of the large onion growers in different parts of the Island, and they were all unanimous in declaring that no such insect as the onion-fly or indeed any kind of insect ever attacked their crops. Further, I examined numerous samples of onions and failed to find any trace either of the insect or its grub. Neither could anything abnormal be detected in the seeds.

The onions have in no way deteriorated in quality during the last few years; the prices are certainly lower, but this is due to the fact that increased production in other parts of the world has lessened the demand, and not to any falling off in the quality of the plants.

The facts that the main crops in the Island still continue good, and that those grown in the United States from seed exported from Teneriffe are successful, seem to prove that the seed itself is good. It cannot be gathered from plants attacked with the Escarcha or Quesillo, as their growth is arrested, and they do not produce heads. It might, however, be advisable to recommend renewed precautions to ensure that none of last year's seed should be mixed with this year's, if, as the growers assert, the seed loses its germinating power after one year. It might also be worth while to try some other means of packing the seed, which would keep it dry, and at the same time admit the access of air. The present method of hermetically sealing it up for four or five weeks, especially if it is not thoroughly dry, may perhaps prove a source of danger.

ARTHUR E. SHIPLEY.

Christ's College, Cambridge.
October 9, 1886.

REPORT by MR. ARTHUR SHIPLEY on the ONION DISEASE in the BERMUDAS.

Preliminary.

At the request of Mr. Secretary Stanhope, I visited the Bermuda Islands in the beginning of the year 1887, to inquire into the causes of a disease prevalent among the onion crops during the preceding seasons, and if possible to suggest remedial measures.

I left England about the middle of January, and reached Bermuda the last day of the same month, and I remained in the Colony until the latter end of April.

The season of the year during which I was in Bermuda permitted me to see the whole growth and method of culture of the onion, from the time when it first appears above ground until it is pulled and packed for exportation.

Whilst in Bermuda I lived at Hamilton, and established there a small laboratory for the experimental investigation of the diseased plants. From Hamilton I visited all parts of the Island, and inspected many plantations. Some of them were suffering from a specific disease, others, however, were simply suffering from drought, which had caused the ends of the leaves to shrivel and fall back; again other crops were looking weak and unhealthy from the poverty of the soil upon which they were cultivated.

During my sojourn in the Bermudas, I received every possible attention and help from the officials of the Colony, and also from the farmers, who afforded me every facility for carrying out my investigations, and I take this opportunity of tendering my thanks for the assistance I received from everyone whilst carrying on my investigations.

On my way back to England I took the opportunity, whilst in the United States, of visiting Professor Farlow, of Harvard University, Cambridge, Mass., the eminent authority upon plant diseases, and consulting with him upon the best remedies to adopt for the disease. Professor Farlow had previously been in correspondence about the onion disease with some of the members of the Agricultural Board.

It was not until I returned to England that I could procure the books necessary for the completion of my report, and here I had the advantage of the assistance of Professor Marshall Ward of the Indian Civil Engineering College, a well-known authority upon fungoid diseases.

Sect. I.—The Disease and its Cause.

Disease during 1887.

The amount of disease amongst the onion plantations during the season of 1887 was decidedly less than during the preceding year. This was probably due to the atmospheric conditions being unfavourable to the propagation and development of the fungus causing the disease.

The cause of the disease.

The disease amongst the onions in Bermuda is caused by the presence of a microscopic fungus which lives parasitically upon the leaves of the Onion plant. This fungus is known to botanists under the name of *Peronospora Schleideniana*, De Bary, (*Botrytis Destructor*, Berkeley,) and amongst the onion farmers of the Old World as the Onion Mildew.

It belongs to the same order of fungi as the well-known potato fungus. Its geographical distribution is not well known, but it occurs in England, Germany, and has, I believe, been found in the United States.

Symptoms of the disease.

The first sign of the disease in an onion-patch is the appearance of a silvery white powder which lies scattered on the upper (inner) surface of the leaves of the onion plant, usually about three or four inches from the base of the leaf. This powdery growth gradually spreads over the whole leaf, which at the same time loses its plump consistency and becomes hard and resistent when felt. After some days the powder which at first has a silvery-white appearance assumes a greyish-black hue.

The leaves of the affected plant maintain their ordinary erect position for some time, their tops then turn inwards, and then ultimately dry up, wither, and fall back. (Fig. 1.)

All growth of the bulb is arrested as soon as the fungus has taken a good hold on the onion plant. This is due to the fact that the nutrition and other functions of the plant are interfered with by the presence of the fungus living parasitically upon the onion leaves. The fungus does not itself attack the bulb, and the bulb does not rot, so that if the plants are attacked when fully grown or almost so, the crop is not destroyed.

On its first appearance the fungus has a stimulating effect upon the growth of the onion plant. This is shown by the shooting up of a long neck between the top of the bulb and the base of the leaves; or, in other words, instead of the leaves separating from one another at the top of the bulb, a long stalk is formed between the bulb and the base of the leaves, Fig. 1. The pressure of this stalk is a sure sign of the existence of the disease, and it affords a ready means of recognising affected plants in a large patch of onions.

Atmospheric conditions favourable to the spread of the disease.

The conditions of the atmosphere which are favourable to the development and growth of the fungus, and hence to the progress of the disease, are heavy dews or rains followed by warm, moist, calm weather, and the absence of direct sunlight and strong winds. Shady and sheltered spots are usually the most liable to be attacked.

The land along the south side of Bermuda usually keeps free from the disease, and this freedom from attack is attributed by the planters to the fact that there the onion plants are exposed to the early morning sun and to the prevalent northerly winds, which rapidly cause the dew to evaporate.

The progress of the disease is sometimes arrested, after it has appeared in a field, by cold windy weather and strong sunshine, but this is rarely the case; as a rule, when it has once appeared it spreads with great rapidity, large fields becoming affected in the course of a single night.

Sect. II.—The Structure and Life-History of the Fungus Peronospora Schleideniana.

Structure of an onion leaf.

In order to fully understand the structure of the fungus *Peronospora Schleideniana* and the various stages of its growth, or its "life-history," it will be necessary to have some idea of the structure of the onion leaf upon which it flourishes.

When a thin slice of an onion leaf is examined through a microscope, it is seen that the tissue of the leaf is built up of a number of small cells, each with a definite wall. Inside this wall is the living matter of the plant, and in the cells near the surface the green substance termed chlorophyll, which gives the plant its characteristic colour. These cells are shown at cc., Fig. 3.

The cells are bounded on the outside by a special layer of cells, which form an outer skin for the leaf. These cells, shown at ep., Fig. 3., differ somewhat in appearance from those within. The layer which they compose is termed the *epidermis*.

On a somewhat closer observation of the slice of onion leaf, it will be noticed that the cells have not their sides in contact at all points, but that spaces occur here and there between the neighbouring cells. Such intercellular spaces are shown at ip., Fig. 3. In other words, the cells are not packed closely together as bricks in a wall, but considerable space exist between them, as between bricks when piled up roughly in a loose heap.

In these spaces between the loosely arranged cells the air circulates freely. No spaces occur between the cells forming the epidermis, but special mouths or *stomata* exist, through which the air can enter, and these circulate through the tissues of the leaf, STO., Fig. 3.

It is of the utmost importance for the health of the plant that these air-passages should be kept open, so that the air can have ready access to the cells of the leaf.

The number of stomata through which the air passes is very great, as many as 70,000 exist upon one square inch of onion leaf.

Structure and life-history of Peronospora and Schleideniana.

Having now considered the structure of the leaf of the onion, we can return to the fungus which lives upon it, and then the importance of this preliminary description will become evident.

Fig. 2. represents the surface of a small piece of the leaf of a diseased onion plant examined under a microscope. The outlines of the cells forming the epidermis are shown at EP.; STO. represents one of the stomata, through which, in the healthy plant the air has access to the spaces between the cells composing the tissue of the leaf. At STO. it will be seen that the opening of the stoma is checked by a tube-like stem (ST.), which protrudes from the leaf.

At its outer end this tube splits into many branches, and at the end of some of the branches is a little oval body, which hangs from it like a drop of water. These little bodies are the *Spores*, and they act as seeds. It is by their means that the fungus is able to reproduce itself. Some of the spores have fallen off from the ends of the branches, and are lying on the leaf (SP.).

This branching stem with its spores is the mature fungus *Peronospora Schleideniana*, and is the collection of these which causes the powdery appearance on the diseased onion leaf.

There is a slight but distinct violet colour seen both in the fungus and its spores.

If a thin slice or section of the diseased onion leaf, which passes directly through one of the stomata, be examined, it will be possible to follow the stem of the fungus through the epidermis into the tissue of the leaf and see what comes of it.

Such a section is represented at Fig. 3; STO. is the stoma, through which emerge in this case two stems. These branch at their outer ends, and some of the branches still bear spores; others, however, have lost them. The lower end of each stem can be traced through the stoma into the leaf, and there it will be seen to split into two tubular root-like processes (TP.), which in their turn branch again, and thus, by continually dividing, a meshwork of tubular roots is formed which passes in every direction through the spaces between the cells.

The injury which the fungus does to the onion plant is chiefly due to this network of roots, and it is of two kinds. Firstly, by blocking up the stomata and the passages between the cells it prevents the circulation of air through the tissues, and thus, in a measure, chokes the plant. Secondly, the fungus lives upon the substance of the plant, absorbing, by means of its meshwork of tubular roots, the nutritive matter formed in the cells of the leaf.

The very intimate relation which exists between the fungus and the tissue of the leaf is most noteworthy. The tubular roots pass everywhere between the loosely arranged cells, forming a complete network in the meshes of which the cells of the leaf lie. The importance of this close connexion will be more evident later when remedial measures are discussed.

As this network of roots grows and spreads through the tissue, some of its tubular branches force their way into the neighbourhood of a stoma, and pass out through it into the air, Fig. 4. ST. The young stem thus formed now commences to fork or branch, as is indicated in Fig. 5, ST. The branches again divide, and ultimately small portions of their tips are constricted off and form the spores before mentioned, It has been stated that the number of stomata upon the Onion leaf is roughly about 70,000 to the square inch. If the onion is badly diseased one of the branching stems of the fungus will be found projecting into the air through about one stoma in every ten. In some cases two (Fig. 3) and even three (Fig. 4) stems may emerge from one stoma, so that on a square inch of a diseased onion leaf we may fairly estimate the number of stems of the fungus as almost one-tenth of the number of stomata, that is 7,000. If we take 20 as the average number of spores upon one stem, and that is rather below than above the average, we find that a single square inch of a diseased onion leaf may have the enormous number of (20 × 7,000) 140,000 spores, each capable of reproducing the fungus, and hence the disease.

Reproduction, *a*. Asexual.

There are two methods by which the onion fungus reproduces itself: *a*, the asexual; *b*, the sexual. The asexual method of reproduction is effected by means of the above-mentioned spores. Each spore is an exceedingly minute sac or bag containing living matter; the shape is oval and rather more pointed at the end attached to the branch than at the other. It has a slight violet tinge.

These spores are, from their minute size and lightness, easily blown about by the wind, and float through the air, and it is by this means, and also by means of insects flying from one onion field to the next, that the spores are carried about and the disease spread over a field, and from one field to another.

Germination.

When one of the spores falls upon an onion leaf it will, providing certain external conditions are present, begin to germinate. These external conditions, which are necessary to the germination of the spore, are, firstly, a certain degree of warmth, and, secondly, a certain degree of moisture,—conditions which, unfortunately, are seldom wanting in Bermuda.

When a spore germinates upon the leaf of an onion it puts forth a long tubular outgrowth, Fig. 6, which makes its way to the nearest stoma and passes through it (Fig. 7). Once inside it begins to branch, forming a network of tubular roots inside the leaf; whilst at the other end the empty spore case drops off and the stem begins to divide up and form branches. Thus from the simple minute spore a fungus has arisen which closely resembles the parent form which bore the spore, and which will in a short time bear spores of its own capable in their turn of reproducing the fungus.

With respect to the germination of these spores and the consequent spread of the disease, two or three points are worthy of comment. Firstly, the spores will only germinate when a certain amount of moisture is present. Hence, when the sun is shining brightly or the wind is blowing and evaporation is promoted, the moisture disappears, the spores do not germinate, and for a time the progress of the disease is checked. On the other hand, during calm, warm, humid weather, the disease spreads with a rapidity which is only intelligible when the enormous number of spores is taken into account. Sharp showers of rain followed by sunshine will also tend to arrest the spread of the

disease, because many of the spores will be washed off by the rain on to the earth where they cannot germinate.

Secondly, the power of germination of the spores is not retained indefinitely. After a certain time the spores die if they have not found the conditions favourable to their development. The length of time during which they retain their vitality varies according to the circumstances ; if dried up, they would die in a day or two, but if the weather were moist they would probably retain their germinating powers some weeks. But as far as is at present known they do not retain their vitality beyond the summer in which they are matured. They would not last over from one season to another.

Thirdly, in connexion with remedial measures, it should be noticed that the spores when ripe and whilst germinating are outside the leaf, and have not entered into that intimate connexion with the tissues of leaf of the onion plant which is characteristic of the mature fungus.

b. Sexual.

It has been stated above that the spores of the fungus do not retain their vitality from one season to another, and it is obvious that the length of life of the mature fungus is limited by that of the onion upon which it lives. Hence there must be some means by which the fungus is enabled to last over the autumn and winter until the young onions of the new crop are ready to afford it a new home. This is effected by means of special cells, termed *Resting-spores*, which are formed in the following way.

Certain of the tubular root-like processes which form the meshwork inside the tissue of the leaf swell up at their ends. Thus a knob is formed full of living matter, and this is cut off from the contents of the rest of the fungus by the formation of a transverse partition. In the same neighbourhood as this knob a similar but smaller one is formed in much the same way. When these are both ripe a small canal is formed which connects the two knobs, and the contents of the smaller one passes through into the larger, and there fuses with the contents of the latter (Fig. 8). After this is accomplished the larger knob surrounds itself with a very thick wall or coat, and is now termed a resting-spore (Fig. 9).

A very large number of these resting-spores are formed, so that in a section of an onion leaf, which has been diseased for some time, a great number of these, each surrounded by a thick coat, are formed.

The function of these resting-spores is a very important one : it is by their means that the fungus is kept alive from one season to another. Their vitality is very great ; not only do they retain their power of germinating for a great length of time, probably for two or three years, but they are capable of withstanding considerable variations in the degree of temperature and moisture. This is largely owing to the thick wall which encases them.

When a field of onions has been destroyed by the Onion fungus, the withered leaves are crammed with resting-spores. The leaves fall to the ground, carrying with them thousands of these little bodies, any one of which is capable of reproducing the fungus, and hence the disease. They remain in the dried up leaves, or if the leaves are dug in, in the ground, until a new crop of onions grows up, the leaves of which afford them a suitable home. Then with the first moist warm day they begin to germinate, and soon the new crop of onions falls a victim to the fungus, produced from resting-spores which were themselves produced from the fungus of the preceding crop.

Sect. III.—The Origin of the Disease.

It is impossible to say by what means the fungus *Peronospora Schleideniana* first reached Bermuda. There is but little doubt that the disease is identical with that which occurs occasionally in the Canary Islands, and which is known there as La Ceniza or La Escarcha, so that it is possible that it may have been imported thence with the onion seed, or more likely on the leaves of some onion plant. On the other hand, microscopic examination of many specimens of onion seed, brought over from the islands of Teneriffe and Palma, failed to reveal any traces of the spores of the fungus; and onions were raised from this seed, both in the Botanical Gardens of Kew and Cambridge, which were perfectly free from the disease. It is also to be observed that the wide distribution which the fungus is known to have—being found in many European countries as well as in some parts of the United States—would render it difficult to obtain seed suitable for the Bermuda market which would be entirely above suspicion.

The thick black coat which covers the seed is too dense and hard to be penetrated by the fungus, so that the seed cannot be directly injured by the fungus nor its germinating power affected. Although, in my opinion, the danger of infection by the seed is but very slight, I have in the section upon remedial measures suggested a method by which any spores existing in the seed might be destroyed without injuring the seed itself.

Connexion between artificial manures and fungoid diseases.

There seems to be some connexion between the extensive use of artificial manures and the origin and spread of fungoid diseases. The potato is frequently attacked and large crops destroyed by fungus which is nearly related to that causing the onion disease. The potato was introduced into England 300 years ago, and for about 250 years it flourished without, as far as is known, any disease appearing among the cultivated varieties. But about 50 years ago, the Potato Fungus, *Peronospora infestans* (Phytophthora infestans, De Bary) made its appearance, and has never since disappeared. Its appearance was roughly coincident with the first general use of artificial manures. A similar connexion might be shown to exist between the origin and spread of the onion disease fungus, which did not make its appearance till eight or 10 years ago, and the recent extensive use of artificial manures in the Bermudas.

Sect. IV.—Remedial Measures.

The question of remedial measures may be considered under three heads:—

i. What means may be taken to strengthen the onion plant, so that it may be better able to withstand the attack of the fungus when it makes its appearance?

ii. What means may be adopted to prevent the appearance of the disease another year, or how can the disease be stamped out?

iii. What curative methods can be employed when the fungus has appeared, and what means should be taken to prevent its spreading?

Strengthening the plant strain.

i. At present no one strain of onions is known to withstand the attack of the fungus better than another. Any experiments carried on with a view of testing the relative power of resisting the disease among the

numerous varieties of onions would necessarily require observations extending over some years. As far as is known at present the *red* varieties of onions suffer rather less than the white, but our knowledge on this subject is too meagre to justify any recommendations as to changing the seed.

The diseased onions do not produce flower heads ; there is, therefore, no fear that the seed is being weakened by being gathered from diseased plants.

Situation. It will be obvious from what has been said above with regard to the germination of the spores, that whenever it is possible onions should be sown where they will obtain the morning sun and a fresh breeze. They should never be placed at the bottom of a hollow, nor in any position which is too sheltered either from the sun or wind. That the sun and wind have a great influence in arresting the disease is shown by the fact that the disease is practically unknown on the southern side of the Islands.

Transplanting. The practice of transplanting the young onion undoubtedly weakens the plant for some little time, until its roots have taken hold of the new ground. Hence the plant at this period is peculiarly susceptible to the disease. In most parts of the United States and in some countries of Europe the seeds are sown generally by means of a drill, at such a distance apart as is deemed necessary for the bulb to fill, and the onion is never transplanted. By this means a period of weakness is avoided, during which the plant would be ill-prepared to resist the disease should it appear.

Manure. It is important to emphasise the fact that manures must not be looked upon as a means of curing the disease, but simply as a means of strengthening the crop of onions.

With regard to the kind of manure it is the universal opinion amongst the onion-cultivators of Europe and America that natural manures are preferable to artificial. Of these that from the hog-pen is perhaps the best, and an excellent manure for onions is made by putting seaweed under the hogs. Stable manure is also very valuable, but it cannot be too strongly stated that the liquid parts of the natural manures are the most valuable, hence care must be taken to prevent their draining away. The manure should be well rotted ; during the fermentation which then goes on it loses little of its valuable constituents whilst it becomes more concentrated. At the same time some of its constituents are rendered more soluble, and hence are more easily washed into the soil and more readily taken up by the plant. If kept in heaps it should be turned once or twice, as by this means many of the seeds of weeds are destroyed.

Owing to the impossibility of keeping much stock in Bermuda the demand for farmyard manures greatly exceeds the supply. In this connexion it is worth drawing the attention of farmers to the compressed manure which is now being prepared by the Horse Car Companies of New York and Philadelphia, and sold by them at a moderate price.

Another manure which has been highly recommended for onions is wood ashes, either scattered on the surface at the time of sowing or mixed with swamp-muck in the proportion of one load of ashes to 10 or 12 of muck. This is said to answer well, but the large per-centage of potash in the ashes might, in my opinion, be dangerous where the onion disease is prevalent, as it has recently been suggested that potash manures foster the development and growth of fungoid diseases.

Guano is a very good manure when used in conjunction with others, but it should not be relied upon to the exclusion of natural manures. Owing to its very variable composition it should always be purchased on analysis, and samples should be analysed from time to time to see that what is supplied is up to the standard.

Weeds.

It is needless to insist upon the necessity of keeping the ground clean and free from all weeds, which should, when gathered together, be burnt.

Measures for stamping out the disease.

ii. When the onion disease has attacked the crops our attention is directed to two problems: Firstly, how to cure the crop; and, secondly, how to prevent the disease spreading. I have postponed considering what means may be adopted with a view of curing the diseased plants until the third part of this section, and at present I propose to consider what means may be adopted with a view of preventing the spread of the disease both as regards space and time. How can the disease be prevented from passing from one field to the neighbouring fields, or from one season to the next?

The means by which the fungus spreads from one centre in a field all over it and thence into neighbouring plantations are, as we have seen above, the small spores which are abstricted from the ends of the branches of the fungus.

Owing to their very minute size and their lightness they float easily in the air, and are borne in countless numbers towards whichever direction the wind sets. Other agents by which they are dispersed are insects, birds, and even snails and slugs; in short, the spores may fall upon anything and be carried into another plantation.

The spores exist in such countless millions that when the weather is favourable, that is, warm and moist, the disease spreads with such rapidity that it is impossible to cope with it. But, on the other hand, if after the first appearance of the fungus the weather should change and become cold and dry, the disease will probably be confined to a small area of the affected field, and in this case efforts may be made to arrest the progress of the disease with some chance of success.

All affected plants must be carefully collected and *burnt*. Since the presence of the fungus on an onion arrests the growth of the plant but little is lost by collecting the diseased parts, that is, the leaves. The bulb, if it is already formed, may still be used.

Great care should be exercised in collecting the diseased plants, so as to avoid as much as possible knocking off the spores, and the plants should be carried off the field in some closed receptacle, such as a tin box. If carried off loosely or in a basket there is much danger of the collector spreading the disease.

The parts collected should be carefully burned. As we have seen, the fungus bears millions of spores capable of reproducing the disease at once; and it also at a later stage produces immense numbers of resting-spores, which are capable of living in the earth until the next season, and then germinating on the new crop and so carrying on the disease from one season to another. So that by burning the affected onions we destroy both kinds of spores and greatly diminish the chance of its spreading.

When it is impossible to burn the refuse it should be mixed with quicklime and buried at a considerable depth, but whenever it is possible, burning is safer.

The same recommendations also apply when the disease is at its worst. If a field of onions has been completely destroyed by the disease, the

refuse of the plants must be burned. *On no account must the refuse be dug into the ground;* this is simply sowing the seed for a new crop of fungus, which will be waiting for the next lot of onions planted on the land.

If, whenever the disease makes its appearance, the affected parts of the onion are burned, there is some hope that in course of time the disease may be stamped out of the Islands. But this is only likely to be the case if the destruction of the refuse is universally practised. It is little use for one farmer to burn the diseased plants if his neighbour does not. And it must always be borne in mind that a small patch of diseased onions, only a few square yards in area, will produce enough spores to infect every onion plantation in the Islands.

It has been shown that the onion disease is perpetuated from one season to another by means of resting spores which lie in the ground during the summer and autumn, and which germinate when the new crop of onions begins to appear. In northern climates it is probable that many of the resting-spores are killed by the frost; unfortunately we cannot reckon upon the assistance of this agent in Bermuda.

Rotation of crops.

But the fact that resting spores are in the ground suggests the advisability of rotating the crops. Although most crops when highly cultivated suffer from one or more fungoid diseases, the diseases are not as a rule interchangeable. For instance, the fungus of the potato disease does not attack onions, and the onion fungus cannot live upon tomatoes. Hence, if potatoes or tomatoes be planted in a field, the earth of which is full of the resting spores of the onion fungus, the latter will not germinate and ultimately die.

There have been no direct experiments to determine how long the resting-spores of the onion fungus retain their power of germination, but probably not for more than two or three years. Hence, if a piece of land has been severely visited by the disease, it would be advisable to plant it with a different crop for a year or two. This would afford some chance of the resting-spores dying out.

The rotation of crops, principally with potatoes, is universally practised by the onion farmers of the Canary Islands, and is the common practice in Europe, not so much because of the disease, but as a means of preventing the exhaustion of the soil. Hence, apart from the chance of diminishing the amount of the disease, it would be advantageous to adopt this method of culture.

Deep trenching.

In cases where it is impossible to rotate the crops, and where onions must be planted in ground which was infected last year, deep trenching may be recommended. By this means the resting-spores would be buried at such a depth that they would fail to reach the surface and come in contact with the new onion crop.

Early sowing.

Planting early in the autumn has been found to answer well in England as a means of avoiding the disease. When this is done the onions are fully grown before the weather is warm and moist enough for the fungus to make its appearance. Owing to the difference in climate between England and Bermuda, it is hardly safe to predict that the same result would follow in the latter place, but the experiment might be tried.

If there is any reason to suspect that the farmyard manure is a means of infection, through some refuse of a diseased onion crop being mixed with it, or from any other cause, it would be advisable to water the manure with a weak solution of iron sulphate (F_2SO_4) before putting it on the land. One-tenth of a gramme in 100 grammes of

water, or a solution of one-tenth per cent. is sufficiently strong to kill the spores of the fungus. Again, if the seed is considered to convey the infection, they may be soaked in a solution of the same strength. This will effectually kill all the spores of the fungus, and leave the seed entirely uninjured.

Curative manures.

iii. In looking for some curative means by which it may be possible to rid the onion crop of the disease, the value of the knowledge of the life-history of the fungus causing the disease becomes apparent. For the question now arises, at what stage in the life-history of the fungus should we apply such chemical remedies as we may have at our disposal.

We have seen that the fungus in its mature condition is structurally in intimate connexion with the tissue of the onion leaf. The root-like processes of the fungus form a network which everywhere penetrates the tissue, and the greater part of the fungus spends the whole of its life inside the leaf. It is obviously not advisable to attempt to kill the fungus at this stage, since any chemicals which would act upon the fungus would be almost sure to injure the leaf of the onion plant.

On the other hand, when the spores are germinating on the leaf they are outside the tissue, and have not entered into any close relation with the plant. Furthermore, the first outgrowths from the spores are very delicate and more easily acted upon by chemicals than the older parts of the fungus, so that when a patch of onions shows signs of the presence of the disease the remedies should be at once applied, not so much with the hope of destroying the mature fungus already there, but with a view of destroying the spores which it bears while they are germinating, and thus arresting the progress of the disease both in the affected plants and also from them to others.

Quicklime and sulphur.

The first of the chemical remedies which may be applied to the diseased plants with considerable prospect of success is a mixture of freshly burnt quicklime and sulphur.

There can be no difficulty in obtaining plenty of quicklime in Bermuda, and for this purpose it must always be used when freshly burnt as quicklime loses its caustic properties and undergoes chemical change when kept any length of time. After burning it should be crushed to a powder and mixed with powdered sulphur in the proportion of two parts of quicklime to one part of sulphur.

This mixture may be sprinkled on the diseased plants by hand or more effectively by means of bellows, such as the Kentish hop-growers use for sulphuring the hops.

The mixture should be applied before the dew is off the plants or after rain whilst the plant is still wet.

The chemical interaction which is produced by the mixture of sulphur and freshly-burnt quicklime leads to the formation of sulphurous acid and other allied gases. The gases are evolved slowly, and being readily diffusible they soon spread over the plant, and being easily soluble in water they dissolve in any moisture in the leaves, &c. The solution thus formed is strong enough to kill the germinating spores without injuring the plant, and it does not become concentrated to a dangerous degree. The final products are not harmful to the plant or soil, and the chief use of sulphate of lime is a valuable manure, especially in Bermuda, where the amount of sulphur in the soil is very slight.

Iron sulphate.

A second chemical remedy which may be used for the onion disease is iron sulphate (F_2SO_4), and this has the advantage of being readily soluble in water, and hence can be applied in the liquid form. When in a weak solution the iron sulphate will kill the fungus

without killing the onion plant. The solution should contain one-tenth part F_2SO_4 to 100 parts of water. It may even be made as strong as three-twentieths per cent. without injury to the plant, but anything stronger than this is like to prove injurious.

The diseased onions may be watered with this, or, still better, sprayed thoroughly. The ground in the vicinity of the affected plants may also be watered with advantage with this solution; in this way any spores which have fallen off will be destroyed.

In addition to its antiseptic properties iron sulphate forms a very valuable manure. In a paper published in the Journal of the Chemical Society, 1886, Mr. Griffiths has described many experiments which all tend to show the value of this chemical as a manure. I will content myself with quoting from his paper the results of one experiment. Mr. Griffiths sowed three plots of ground the same size with potatoes. The first plot of ground was not manured; from this he gathered three tons of potatoes. The second plot, which was well manured, gave six and a half tons; whilst from a third plot, which was well manured in the same way as the second, but with the addition of iron sulphate, he obtained eight and a half tons of potatoes. This is only one experiment out of many which all tend to show the value of iron sulphate as a manure.

The iron sulphate should be applied as a top-dressing after the plants have been transplanted. About half a hundredweight should be used to the acre: more than this is apt to prove harmful.

It has been found that wheat crops grown in fields manured with iron sulphate do not suffer with the wheat mildew, and it is very probable that if the land be treated in the manner indicated, potato and onion crops would also escape the fungus.*

Iron sulphate has the further advantage of being very easily obtainable at a very moderate cost.

Sect. V.—Macrosporium Parasiticum.

There is a second fungus found living upon the onion plant. This is known as *Macrosporium parasiticum*, and it is one of the Pleosporous Ascomycetes.

This fungus is only found upon the onion after it has been attacked by the *Peronospora*, when the leaves are already dead or dying. It does not attack the healthy plant.

Macrosporium belongs to that class of fungi which are known as Saprophytes; these are characterised by living upon dead or decaying organic matter. They are unable to effect a foothold upon the healthy plant. Hence if the *Peronospora* can be exterminated, the *Macrosporium* will disappear at the same time.

The fact that the *Macrosporium* is, so to speak, a sequel to the *Peronospora*, and that with the extermination of the former the latter will disappear, renders it unnecessary to describe the very complicated and incompletely known life history of the fungus. But a short account of its naked-eye appearance may be given.

After the plant has already been weakened by the *Peronospora*, the *Macrosporium* makes its appearance as patches of a deep black colour and velvety appearance. These gradually spread, forming belts an inch or more wide round the leaf. This dense black appearance is followed by a fluffy white growth, which stands out from the leaf for the distance

* All the remedies suggested for the onion disease apply with equal force to the potato disease, which is caused by a fungus, *Peronospora infestans*, a species distinct from *Peronospora Schleideniana*, but resembling it in its life-history.

of one-tenth inch. Whilst the *Macrosporium* is growing the leaf continues to rot; it does not dry up as it does when only attacked by the *Peronospora*, but the plant retains a good deal of moisture, and when thoroughly rotten gives rise to a most offensive smell. The bulb is also sometimes affected.

The dense black colour of this fungus is so much more conspicuous than the whitish powder of the *Peronospora* that it is sometimes stated to attack onion crops which have not suffered from the *Peronospora*. Closer observation, however, shows that it invariably follows the fungus.

It is the *Peronospora* which does the great harm to the onion crops, and the *Macrosporium* is only a sequel to it. Hence all remedial measures must be directed against the former, for with its extermination the *Macrosporium* will disappear.

Sect. VI.—Insects.

There is a very minute insect, a species of Thrips, which occurs occasionally, though not in any great numbers, at the top of the bulb in the angles between the leaves of the full-grown onion plant. It occurs in the onions usually in the larval condition, as a yellowish white grub with three pairs of legs, but no wings. During this stage it lives upon the substance of the onion leaf. The adult insect has a much darker, brown and black appearance, and is provided with two pairs of wings. In this stage it is very much less common in the leaf than in the larval condition.

This insect was found in comparatively few farms, and then in very limited numbers. It does not burrow through the leaf, and appears to cause very little damage to the onion plant. Should, however, the numbers increase largely, or should it appear upon the young seedlings, it might be the cause of serious loss.

A simple way of getting rid of it is to water or spray the affected plants with a solution of iron sulphate, such as was recommended in Sect. IV. iii. This would more particularly prove effective in the case of the onion, because some of the solution would collect in the angles of the leaves where the insect most commonly occurs.

The onion fly, *Anthomyia ceparum*, whose maggots do much harm by eating through the bulb of the onion, occurs so rarely in Bermuda, that it hardly calls for remark in this report. I only met with a single instance of it during my stay in the Colony.

In case, however, that it should at any future time prove troublesome, it is worth mentioning here that Miss Ormerod has successfully dealt with this insect by covering the bulbs with a thin layer of earth, so that they no longer stand out of the ground. This in no way injures the plant, and prevents the fly getting at the bulb to lay its eggs.

Sect. VII.—Summary.

1. The onion disease is caused by a fungus *Peronospora Schleideniana*, which lives parasitically upon the leaf of the onion plant.

2. The atmospheric conditions which favour the progress of the disease are heavy dews or rains followed by warm, moist, calm weather, and the absence of direct sunshine and cold winds. In favourable weather the progress of the disease is very rapid.

3. The fungus lives in the tissues of the leaf, choking up the air passages and absorbing the nutritive fluid formed in the cells. Its

stem protudes through the stomata of the leaf into the air. Its branches bear spores at their tips.

4. The reproduction of the fungus is effected by means of these spores which float about through the air, and also by means of certain special cells formed by the fungus and known as resting-spores. These pass the winter in the earth, and are capable of retaining the power of germination for two or three years. It is by their means that the disease is carried on from one season to another.

5. One method of combating the disease is to make the onion plants as strong as possible, so as to withstand the attacks of the parasite. Hence the site should be carefully selected, the soil well prepared, good manures used, and the land kept clean and free from weeds.

6. To prevent the spreading of the disease all affected plants must be collected and burned. Whilst doing this care must be taken that the collector does not himself spread the disease by carrying the refuse loosely. Rotation of crops, or, when this is impossible, deep trenching, would lessen the chance of the disease appearing.

7. Diseased plants may be treated with a mixture of powdered sulphur and freshly burnt quicklime sprinkled by hand or by bellows; or they may be washed or sprayed with a weak solution of iron sulphate (green vitriol). In both cases the fungus is destroyed without injury to the onion plant. Further, both these chemical remedies have the additional advantage of being excellent manures.

8. Another fungus, *Macrosporium parasiticum* sometimes attacks the onions after the *Peronospora* has taken a good hold of the plant and weakened it. As this only occurs as a sequel to the *Peronospora*, the extermination of the latter would involve the disappearance of the former. The *Macrosporium* does not attack the healthy plant.

9. Only two kinds of insects, the onion thrips and the onion fly were met with, and the latter on only one occasion. The thrips were not numerous and appeared to do little harm. They can easily be removed by application of a solution of iron sulphate, such as is recommended in Section IV. iii.

Should the onion fly ever prove a serious pest it may be dealt with by covering the bulb of the onion with a thin layer of earth. This prevents the fly approaching the bulb to lay its eggs.

(Signed) ARTHUR E. SHIPLEY.

Christ's College,
Cambridge,
August 3, 1887.

EXPLANATION OF PLATE I.

Fig. 1.—An onion plant which has suffered severely from the disease, showing the withered bent-down leaves and the long stalk.

Fig. 2.—Surface view of the epidermis of an onion leaf with a fungus stem protruding through a stoma. Magnified about 200 diameters. EP., epidermal cells; SP., spores; ST., stem of fungus (*P. Schleideniana*); STO., stomata.

Fig. 3.—Section through an onion leaf, showing cells of the leaf and the air spaces between them in which the root-like processes of the fungus grow. The section passes through a stoma, and shows two stems of the fungus passing into the air and bearing spores (× 200); CC., chlorophyll cells, which give the leaf its green colour; DC., deeper cells not containing chlorophyll; EP., epidermal cells; IP., air passages between the cells; SP., spores; ST., stem of the fungus; STO., stomata; TP., tubular processes ramifying in the air passages.

1

SP
EP
STO
2
SP
ST
3
SP
ST
EP
STO
CC
TP
TP
IP
DC

Peronospora Schleideniana, De Bary. PLATE I.

EXPLANATION OF PLATE II.

Fig. 4.—Surface view of epidermis of onion leaf showing a young stem protruding through a stoma. EP., epidermal cells; ST., stem; STO., stoma.

Fig. 5.—A slighter older stem beginning to branch; letters as in Fig. 4.

Fig. 6.—A spore beginning to germinate; T., tubular outgrowth.

Fig. 7.—A spore germinating; a tubular outgrowth entering the leaf through the stoma; SP., spore; T., tubular outgrowth; STO., stoma.

Fig. 8.—The formation of the resting-spores; AN., small knob (*Antheridium*); OG., large knob (*Oognium*).

Fig. 9.—The resting-spores with their thick cell-walls.



Peronospora Schleideniana, De Bary. PLATE II.

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ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 11.] NOVEMBER. [1887.

XX.—COLONIAL FRUIT.

One of the most recent efforts of the Colonies to utilise their natural resources has been directed to the subject of fruit.

Where, as in the West Indies, fruit can be grown in large quantities and finds a ready market in the United States of America, it is but natural that planters, under circumstances of depression in other commodities, should turn their attention to fruit growing. In Colonies not so favourably suited as the West Indies as regards convenient markets, growing fruit and exporting it in a fresh state necessarily requires special arrangements for packing and shipping. If such arrangements were available at moderate rates there is little doubt large quantities of fruit could be grown and exported from Cape Colony, Natal, the Australian Colonies, and New Zealand.

Much of this, arriving in England during the winter and early spring months, would be readily bought to supply the wants of the community, and the prices paid for such fruit as an article of luxury would doubtless

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1887.

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be sufficiently high to cover the cost of bringing it from the Southern Hemisphere. Consequent upon the interest taken in fruit shown from all parts of the Empire at the late Colonial and Indian Exhibition, an effort has been made by this establishment to collect information as regards the capabilities of each Colony to grow and export fruit, and this information it is proposed to publish in this and subsequent numbers of the *Kew Bulletin*. As introductory to the information now given, those interested in the subject may usefully refer to the article "Fruit" in the "Reports of the Colonial and Indian Exhibition, 1886" [London: Clowes and Sons], and to a paper on "Fruit as a Factor in Colonial Commerce" published in the "Proceedings" of the Royal Colonial Institute, Vol. XVIII., 1886-87, pp. 123-159 [London: Sampson Low].

Royal Gardens, Kew, to Colonial Office.

Royal Gardens, Kew,
14th August 1886.

Sir,

I have the honour to report, for the information of the Secretary of State for the Colonies, that considerable interest has been awakened in regard to tropical and other fruits by the display of fruits in the several courts at the Colonial and Indian Exhibition, and by the sale of fresh fruit in the Colonial market attached to this Exhibition.

2. The fact that excellent fruits, such as oranges, lemons, pears, apples, &c., can be obtained in a fresh state from the Southern Hemisphere (Natal, Australia, &c.) at a time when fruits of this kind are not obtainable in the Northern Hemisphere has suggested the idea that the resources of our Colonial possessions in this respect are capable of considerable expansion, and the subject one well worthy of being thoroughly investigated.

3. The abundant character and the high qualities of the tropical fruits of the West Indies are well known, but it was only the other day (on the occasion of a lecture which I gave at the Colonial and Indian Exhibition) that many people realised that these fruits can be brought to England in a fresh state and are capable of contributing largely to the food supply of the inhabitants of these islands.

4. The fruit trade in the West India Islands is now of the estimated annual value of 750,000*l.*; but if suitable markets were forthcoming, and knowledge enlarged on the subject, there is no reason why this trade should not assume such proportions as would go a good way towards relieving the depression under which these islands are at present labouring.

5. As regards the actual capabilities in this direction of other portions of the Empire, and especially of the Cape and Australian Colonies, little is accurately known at home; and hence I would venture to suggest that inquiry be made, and a summary of information published calculated to draw particular attention to the subject.

6. I enclose herewith a number of questions which I have submitted to Mr. Thiselton Dyer, and I am directed by him to convey his approval of them, and to suggest that a copy of these questions be forwarded to each of the Colonial Governments with the request that the information desired be supplied as fully as possible, together with

copies of any official reports, documents, or returns published in the Colonies directly or indirectly bearing upon the subject.

I have, &c.
(Signed) D. Morris,
Assistant Director.

The Hon. R. H. Meade, C.B.,
Colonial Office.

Enclosure.

Information desired respecting Colonial Fruits.

1. Please give a list (giving both local and scientific names) of the chief fruits grown in the Colony in order of importance.

2. During what months are the chief fruits obtainable? What quantities of each (approximately) are available for export, and what are the wholesale prices locally?

3. What fruits are at present exported (1) in a fresh, or (2) in a preserved state? Please state the destination, the quantity, and the estimated value of each sort.

4. Are all or any of the fruits mentioned above capable of being produced in much larger quantities than at present? If so, what steps are necessary to start or develop a fruit trade; and what inducements, if any, do local men especially desire to open or extend a trade in fresh or preserved fruits, either with the Mother Country or neighbouring States?

5. What fruits are now imported into the Colony, either fresh or preserved? Please state kind, quantity, and value, and the market from whence derived.

6. Please add any special points of interest connected with the fruits of the Colony herein reported upon which are desirable to place on record.

Colonial Office to Royal Gardens, Kew.

Colonial Office,
September 16, 1886.

Sir,

I am directed by Mr. Secretary Stanhope to acknowledge the receipt of your letter of the 14th of August calling attention to the interest which has been awakened in regard to tropical and other fruits by the display in the several courts at the Colonial and Indian Exhibition, and enclosing a list of questions respecting Colonial fruits which you suggest should be answered as fully as possible by the Colonial Governments.

In reply I am to request that you will state to Mr. Thiselton Dyer that Mr. Stanhope fully concurs as to the desirability of obtaining such information, and he therefore proposes to transmit a copy of your

letter and its enclosures to the Governors of Colonies in a Circular Despatch which he is about to address to them.

I am, &c.
(Signed) R. H. MEADE.

The Assistant Director, Royal
Botanic Gardens, Kew.

CANADIAN FRUITS.

REPORT of a COMMITTEE of the HONOURABLE THE PRIVY COUNCIL FOR CANADA, approved by His Excellency the Governor-General in Council on the 19th July 1887.

The Committee of the Privy Council have had under consideration a Circular Despatch, dated 17th November 1886, from the Right Honourable the Secretary of State for the Colonies, transmitting a copy of . . . . a letter from the Assistant Director of the Royal Botanic Gardens, Kew, calling attention to the interest which has been awakened in regard to tropical and other fruits by the display in the several courts at the Colonial and Indian Exhibition, and enclosing a list of questions respecting Colonial fruits, which he suggests should be answered as fully as possible by the Colonial Governments.

The Minister of Agriculture, to whom the Despatch and enclosures were referred to report relative to fruits asked for in the letter from the Assistant Director of the Royal Botanic Gardens, Kew, submits the accompanying report of Professor Saunders, Director of the Experimental Farms of Canada, containing categorical answers to a series of questions for the purpose of obtaining information respecting Colonial fruits.

JOHN J. MCGEE,
Clerk, Privy Council.

MEMORANDUM by PROFESSOR SAUNDERS.

Query 1.—Please give a list of both local and scientific names of the chief fruits grown in the Colony in order of importance.

In replying to this query it has been thought best to append a brief description of each important commercial variety, so as to indicate more clearly their special points of merit. Differences of opinion exist as to the relative value of the several fruits referred to, owing partly to variety of taste, and partly to the modifying influences of situation, soil, and climate ; hence the accompanying list must be regarded as approximative rather than authoritative in this particular.

The Apple.

Baldwin.

A handsome apple of American origin. Free, vigorous, and productive. Fruit medium to large, nearly covered with red. Flesh juicy, crisp, and of fair flavour. An excellent keeper, and although variable in quality usually commands a good price in the market. Season, November to March. Is grown largely for shipment to Great Britain.

Golden Russet.

Also of American origin. An apple of fine quality and very productive. Fruit medium in size, dull yellow, thickly sprinkled with russet. Flesh juicy, crisp, and high flavoured. Season, November to February. Extensively grown for foreign shipment.

Northern Spy.

Of American origin. One of the best winter apples, of excellent quality either for dessert or cooking. Fruit of large size, pale yellow colour, with stripes of purplish red, covered with a thin white bloom. Season, December to May. Much grown for both home market and export. The trees are slow in coming into bearing, but afterwards produce regular crops.

King. (King of Tomkins Co.)

Believed to be of American origin. A large apple of a deep yellow colour, splashed and shaded with red. Flesh yellowish, juicy, with a rich aromatic flavour. Season, November to February. Tree a strong grower and moderately productive.

Ribston Pippin.

A highly-esteemed English apple of medium size. Colour greenish yellow with some russet about the stem, and clouded with dull red on the side exposed to the sun. Flesh deep yellow, crisp, with a rich aromatic flavour. Season, November to March. Tree forms a spreading top, and is a variable bearer, for which reason it is not largely grown.

Canada Reinette.

Probably of Canadian origin. A large and handsome apple, greenish shaded with brown, and sprinkled with dots and patches of russet. Flesh nearly white, rather firm, juicy, with a subacid flavour. Season, January to April. Tree vigorous and productive.

Red Canada.

Origin unknown. A slender growing tree, but productive. Fruit of medium size, yellow shaded with deep red, sprinkled with grey and greenish dots. Flesh white, tender, crisp, and juicy, with a delicate flavour. Season, January to April.

Rambo.

A popular early winter apple, valuable either for the table or kitchen. Size medium, colour yellowish white, marbled with pale yellow and red, and speckled with large brownish dots. Flesh nearly white, tender, rich, and mildly subacid. Season, October to December.

Colvert.

An old variety of uncertain origin. Fruit large, greenish yellow, striped and shaded with dull red. Flesh greenish white, tender, subacid. Season, October and November. Tree vigorous and very productive.

Wagener.

An American variety which originated in New York. Tree an early and abundant bearer. Fruit of medium size, dull yellow shaded with crimson. Flesh yellowish white, fine grained, crisp, juicy, and of good flavour. A good dessert fruit. Season, November to February.

Grimes' Golden.

This is an American apple which originated in Virginia. Tree vigorous, hardy, and productive. Fruit of medium size, golden yellow with pale yellow flesh; crisp, juicy, rich, and spicy. Season, December to March. An excellent dessert apple.

Vandevere.

An American sort. Fruit medium size, colour pale yellow, striped and sprinkled with greenish dots. Flesh yellowish, tender, with a rich aromatic flavour. Season, November to February.

Rhode Island Greening.

An American apple. A vigorous strong grower, and productive. Fruit large, dark green, becoming greenish yellow when ripe. Flesh yellowish, tender, crisp, juicy, and subacid. Much appreciated as a cooking apple.

Swaar.

An American variety which originated in New York. Size medium to large, colour greenish yellow, becoming almost golden when ripe, dotted with brown specks, and marbled with russet around the stem. Flesh yellowish, fine grained, tender, and aromatic. Of excellent quality. Season, November to March.

Roxbury Russet.

Originated in Massachusetts. Tree a healthy vigorous grower and very productive. Fruit of medium size, green russet, becoming brownish yellow when ripe. Flesh greenish white, moderately juicy, and of fair quality. A long keeper, which, if well kept, may be marketed in March or June.

Pomme Grise.

A small russet apple, probably of French origin. Tree a medium grower and good bearer. Colour of fruit grey or cinnamon russet. Flesh tender, rich, and high flavoured. An excellent dessert apple. Season, December to February.

Cox's Orange Pippin.

An English apple much esteemed as a dessert fruit. Tree rather slow in growth, but a good bearer. Fruit under medium size, yellowish, splashed, and mottled with crimson. Flesh yellowish, juicy, rich, and high flavoured. Season, autumn months up to November.

Dominie.

Origin unknown. Tree hardy, a rapid grower, and abundant bearer. Fruit of medium size, colour greenish yellow, splashed with red. Flesh white, tender, and juicy, with a pleasant flavour. A long-keeping winter fruit. In season from December to April.

Ben Davis.

Of American origin. Tree very hardy, a free grower, and abundant bearer. Fruit medium to large, almost covered with red. Flesh white, moderately, juicy, subacid. An apple of fine appearance and a good keeper, but inferior in quality. Season, December to March.

Westfield seek no Further.

An old and highly-esteemed American variety. Fruit medium to large in size, colour dull red on a pale green ground. Flesh white, fine grained, tender, and high flavoured. Season, October to January.

Fallawater.

Originated in Pennsylvania. Tree a strong grower and productive. A large apple of a yellowish green colour, shaded with dull red and sprinkled with large grey dots. Flesh juicy, crisp, subacid. Used chiefly for cooking. Season, November to February.

Wealthy.

An American variety which originated in Minnesota. Tree hardy, a vigorous grower and productive. Fruit of medium size, colour deep rich crimson on a pale yellow ground. Flesh white, stained with red, tender, juicy, and of good flavour. A variety which is coming greatly into favour. Season, November to February.

Yellow Bellflower.

An American variety which originated in New Jersey. Tree a moderate grower and a regular and excellent bearer. Fruit large oblong, of a handsome yellow colour, sometimes with a blush on the sunny side.

Flesh tender, juicy, crisp, and subacid. Season, November to February. This variety is extensively grown in Nova Scotia under the name of "Bishop's Pippin."

Jonathan.

Originated in Pennsylvania. Tree hardy, a moderate grower, and productive. Fruit of medium size, ground colour a light yellow, nearly covered with a brilliant dark red. Flesh white, sometimes pinkish, tender, juicy, with a sprightly flavour. Season, November to February.

Talman's Sweet.

A native of Rhode Island. A hardy tree, very vigorous and productive. Size of fruit medium, colour light yellow, generally with a dark line running from stem to calyx. Flesh white, fine grained, sweet. A profitable orchard apple, much esteemed for baking. Season, November to April.

Cayuga Red Streak.

A Connecticut apple. Tree a good grower and regular bearer. A very large and handsome apple of medium quality. Colour greenish yellow marbled with stripes of purplish red. An excellent cooking sort. Season, October to January.

Fameuse.

A justly-celebrated Canadian apple which grows well in many parts of the Dominion, but attains great perfection in the neighbourhood of Montreal. Tree moderately vigorous, hardy, and very productive. Fruit of medium size, colour greenish yellow covered with fine deep red. Flesh remarkably white, tender, juicy, and high flavoured. A handsome and popular dessert fruit. Season, October to December.

Gravenstein.

An apple of German origin. Tree vigorous and productive, an early bearer. Fruit medium to large, colour bright yellow when ripe, dashed and streaked with red and orange. Flesh tender, crisp, juicy, and high flavoured. Successfully and extensively grown for export in the Annapolis Valley, Nova Scotia, where it is produced in great perfection. Season, September and October.

Alexander.

A very large and showy apple of Russian origin. Colour pale orange, brilliantly streaked and marked with bright red. Flesh yellowish white, crisp, and juicy, chiefly used for cooking. Tree hardy and productive. Season, October and November.

Maiden's Blush.

An American apple which originated in New Jersey. A very beautiful fruit of medium size with a delicate waxen appearance. Colour

pale yellow with a bright red or crimson cheek. Flesh white, tender, subacid. Tree a rapid grower and bears large crops. Season, September and October. An excellent apple for cooking or drying.

Keswick Codlin.

A well-known English cooking apple, which is successfully grown in many parts of the Dominion. Tree a moderate grower and an early and abundant bearer. Fruit above medium size, yellow. Flesh yellowish white, juicy, subacid. Season, September and October.

Duchess of Oldenburgh.

A handsome apple of Russian origin, and one of the most profitable sorts in cultivation. The tree is vigorous, an early, regular, and abundant bearer. Fruit of medium size, of a golden yellow colour streaked with red, and with a blush bloom on the surface. Flesh sprightly, juicy, subacid. Season, August and September. Extensively cultivated for the home market, and of late has been exported in considerable quantities.

Red Astrachan.

Another beautiful apple of Russian origin. Tree a free grower and an abundant bearer. Fruit medium size, almost entirely covered with a rich red colour, and coated with a whitish bloom. Flesh white, crisp, juicy, with a rich acid flavour. Season, late in July and August. Extensively grown for market.

Chenango Strawberry.

An American apple which originated in New York. Tree a vigorous grower and productive. Fruit of medium size, colour whitish mottled and splashed with light and dark crimson. Flesh white, tender, juicy, and mildly subacid. Season, September and October. Cultivated chiefly for the home market.

Montreal Peach.

Tree a fair grower and good bearer. Fruit of medium size, very beautiful; colour pale yellow and waxy looking; sometimes with a pretty pale reddish cheek. Flesh white, tender, juicy, and of good quality. Season, September. Is much grown in the Province of Quebec for local markets. Being tender and easily bruised, this apple is not adapted for shipping to distant points.

The Pear.

Pears have been grown in some parts of Ontario for many years past in excess of the local demand, the surplus having found a ready market in the large cities of the United States. The earlier sorts could not be exported to Great Britain without careful selection and cold storage, but the late ripening varieties might be easily exported, and would no

doubt bring remunerative prices, In British Columbia, where the trees appear to be entirely free from blight and do not suffer from frost, pears are grown in the greatest abundanec, and this branch of fruit industry might be extended indefinitely in that Province with much profit.

Winter Nelis.

A winter pear of Flemish origin. Tree hardy, thrifty, and fairly productive. Fruit under medium size, colour yellowish green, covered more or less with russet. Flesh yellowish white, fine grained, melting, with a rich aromatic flavour. Season, December and January.

Beurre Gris d'Hiver Nouveau.

A winter pear of very good quality. Tree moderately productive. Fruit of medium size, obtuse pyriform, colour golden russet, with a reddish cheek. Flesh juicy, melting, sweet, and high flavoured. Season, November to February.

Beurre d'Anjou.

An excellent pear of French origin. Tree of vigorous growth and productive. Fruit large, obtuse pyriform, colour dull green, sometimes faintly shaded with crimson and sprinkled with russet brown and crimson dots. Flesh whitish, juicy, melting, with a pleasant vinous flavour. Season, October and November.

Beurre Hardy.

Tree vigorous grower, hardy, and productive. Fruit large, obtuse pyriform, colour greenish russet, sometimes shaded with brownish red. Flesh buttery, melting, with a brisk vinous flavour. Season, September and October.

Beurre Superfin.

A French variety. Tree healthy, hardy, and a fair bearer. Fruit medium to large, yellow, sometimes shaded with crimson on the sunny side, and thickly sprinkled with minute dots. Flesh very juicy, subacid, with a brisk agreeable flavour. Season, October.

Mount Vernon.

Originated in Roxbury, Massachusetts. Fruit medium in size, obtuse pyriform, colour yellowish russet, becoming brownish red in the sun. Flesh yellowish, juicy, melting, with a pleasant flavour. Season, November and December.

White Doyenne.

This is an old French variety, much esteemed. Tree a moderate grower and heavy bearer. Fruit of medium size, obovate, colour pale yellow, with sometimes a red cheek in the sun. Flesh white, fine

grained, melting, sweet, with a high rich flavour. Season, October to December.

Howell.

An American pear which originated in Connecticut. A vigorous grower and highly productive. Fruit medium to large, rounded pyriform, colour yellow, with small patches and dots of russet. Flesh whitish, juicy, melting, and of fair quality. Season, September and October.

Sheldon.

An American pear which originated in New York. A hardy, vigorous, and productive tree. Fruit medium in size, roundish obovate, colour yellow russet with a greenish tint, becoming sometimes reddish brown in the sun. Flesh whitish, very juicy, sweet, melting, with a rich aromatic flavour. Season, October.

Louise bon de Jersey.

This variety originated in France. The tree is a vigorous grower and productive. Fruit medium to large, oblong pyriform, pale green with a brownish red cheek, dotted with grey. Flesh greenish white, juicy, melting, somewhat astringent, with a rich flavour. Season, September and October.

Seckel.

This is, without doubt, the richest and highest-flavoured pear grown. An American variety which originated near Philadelphia. The tree is vigorous, hardy, and productive. Fruit small, obovate, dull yellowish russet, sometimes with a red russet cheek. Flesh whitish, very juicy, sweet, and melting, with a very rich spicy flavour. Season, September and October.

Beurre Clairgeau.

A very productive and early bearing variety from France. Fruit large pyriform with unequal sides, colour dull yellow, shaded with orange and crimson, and thickly covered with russet dots. Flesh yellowish, buttery, somewhat granular, with a perfumed vinous flavour; of fair quality and handsome appearance. Season, October to December.

Beurre Diel.

A pear of Belgian origin, vigorous and productive. Fruit large, varying from obovate to obtuse pyriform. Skin yellow when ripe, marked with brown dots and marblings of russet. Flesh yellowish white, rather coarse grained, but sweet, rich, and almost melting. Season, October to December.

Dr. Reeder.

A seedling of Winter Nelis, which was grown in New York. Tree very healthy, hardy, and vigorous, and remarkably free from blight. Fruit small to medium, obtuse pyriform, colour yellowish russet. Flesh slightly granular, juicy, melting, sweet, and high flavoured. Season, October and November.

Duchesse d'Angouleme.

A popular variety which originated in France. Tree a vigorous grower and good bearer. Fruit very large, obovate, with an uneven surface, colour greenish yellow, spotted and streaked with russet. Flesh white, very juicy, sweet, with a rich flavour. Season, October.

Goodale.

An American pear which originated in Maine. Tree hardy, a vigorous grower, and productive. Fruit large, obtuse pyriform, yellow, with patches and dots of russet. Flesh whitish, melting, sweet, and high flavoured. Season, October.

Beurre Box.

A pear of the very highest quality, of Belgian origin. Fruit large and handsome, pyriform, dark yellow, with a light coating of russet. Flesh white, fine grained, melting, with a rich delicious flavour. Season, September and October.

Doyenne Boussock.

Also a Belgian pear. Tree vigorous and productive. Fruit obovate, inclining to pyriform, colour deep yellow, netted with russet and with a reddish cheek. Flesh juicy, melting, sweet, aromatic. Season, September and October.

Flemish Beauty.

Supposed to be of Belgian origin. Tree a strong grower, very hardy and productive. Fruit large, obtuse pyriform, pale yellow, nearly covered with patches of light russet. Flesh yellowish white, juicy, melting, sweet and rich, with a slight musky flavour. Season, September.

Bartlett or Williams' Bonchretian.

One of the most popular of all pears, an English variety, which was early introduced into America. The tree is a rapid grower and an abundant bearer. Fruit of large size, pyriform, yellow when ripe. Flesh white, fair grained, buttery, sweet, juicy, and high flavoured. Season, September.

Clapp's Favourite.

An American pear which originated in Massachusetts. Tree a vigorous grower and an abundant bearer. Fruit large pyriform, pale yellow, faintly marbled and splashed with crimson where exposed to the sun. Flesh white, fine grained, melting, juicy, rich, and sweet. Season, September.

Tyson.

A pear of American origin, a chance seedling found near Philadelphia. Tree a vigorous grower and highly productive. Fruit of medium size, pyriform, deep yellow, slightly russeted with numerous brown dots, and with a more or less crimson cheek. Flesh juicy, melting, very sweet, with an aromatic flavour. Season, August and September.

The Plum.

Plums are grown successfully in different parts of the Provinces of Quebec, Nova Scotia, New Brunswick, and British Columbia; they are also grown in considerable quantities in the western part of Ontario, especially along the shores of Lake Huron, in the district about Goderich, Meaford, and Owen Sound. Many thousands of bushels are sent annually to other points in the Dominion, and large quantities are forwarded to the large cities in the United States. The plums are usually picked before fully ripe, and in this condition and while gradually ripening they will bear transportation and handling for many days without serious injury. The following varieties are among those most esteemed :—

Lombard.

An American plum which originated in New York. The tree is a vigorous grower and an abundant bearer. Fruit of medium size, violet red with a pale bloom. Flesh deep yellow, juicy and pleasant, of medium quality. Season, late in August. One of the most profitable market varieties.

Imperial Gage.

A plum of American origin, raised in Flushing, New York. Tree a rapid grower and most abundant bearer. Fruit above medium size, oval, pale green tinged with yellow, and covered with white bloom. Flesh greenish, juicy, melting, sweet, and rich. Season, early in September.

Green Gage.

A European variety of the highest quality. Tree a slow grower, but an abundant bearer. Fruit rather small, round, green or yellowish green. Flesh pale green, melting, juicy, and of a luscious flavour. Season, middle of August to September

McLaughlin.

An American variety of first quality, which originated in Maine. Tree hardy, vigorous, and productive. Fruit medium to large, nearly round, with a thin tender skin, yellow, dotted and marbled with red on the sunny side, and covered with a thin bloom. Flesh yellow, juicy, sweet, and high flavoured. Season, last of August.

Pond's Seedling.

Of English origin. Tree vigorous and productive. Fruit very large, oval, and of a bright red colour with a whitish bloom. Flesh yellow, a little coarse, juicy, and sweet, but not of first quality. Season, middle of September.

Duane's Purple.

An American plum which originated in New York. Tree a vigorous grower and productive. Fruit large, oval or oblong, swollen on one side of the suture, of a reddish purple colour with yellow specks, and a lilac bloom. Flesh dark yellowish, juicy, sprightly, and moderately sweet. Season, middle to end of August.

Bradshaw.

Tree a vigorous grower and heavy bearer. Fruit, large obovate, of a dark reddish purple colour covered with a light blue bloom. Flesh, yellowish, rather coarse, juicy, sweet, and pleasant. Season, August.

Columbia.

An American variety which originated in New York. Tree vigorous and productive. Fruit very large, nearly globular, brownish purple with a blue bloom. Flesh orange coloured, not very juicy, but sweet and rich when fully ripe. Season, August and September.

Sharpe's Emperor (Victoria).

An English variety. Tree vigorous and productive. Fruit large, nearly oval, colour light lilac and purple on a yellow ground, covered with lilac bloom. Flesh yellow, coarse, not very juicy or sugary. Of medium quality. Season, middle of September.

Washington.

An American variety which originated in New York. Tree a strong grower but only a moderate bearer. Fruit large, nearly round, of a deep yellow colour, with a pale crimson blush or crimson dots. Flesh yellow, fine grained, sweet, and luscious. Season, middle to end of August.

Prince's Yellow Gage.

An American plum which originated on Long Island, New York. Tree hardy and productive. Fruit of medium size, a deep yellow colour, with a whitish bloom. Flesh yellow, rich, and sweet. Season early in August.

Yellow Egg.

A European plum. Tree a fine grower and good bearer. Fruit very large, oval, yellow with numerous white dots and a thin white bloom. Flesh yellow, rather acid until fully ripe. Highly esteemed as a cooking and preserving plum. Season late in August.

Coe's Golden Drop.

An English variety. Tree vigorous and productive. Fruit large, oval, with a well-marked suture, pale yellow, with dark red spots on the sunny side. Flesh yellow, rather firm, adheres to the stone, rich, sweet, and of good flavour. Season, late in August.

The Quince.

Quinces are grown in the Niagara Peninsula, but not in any large quantity and only for home market. The varieties chiefly cultivated are the Orange Quince and Rea's Mammoth.

The Cherry.

The cherry succeeds well in most of the milder sections in Ontario and Quebec, yields large and regular crops in some parts of Nova Scotia, and all the varieties succeed well in British Columbia.

Of the Bigarrean or Heart cherries the following are cultivated in Ontario, the home market being supplied chiefly from those districts adjacent to the great lakes, particularly along the Niagara peninsula :— Black Eagle, Black Tartarian, Downer's Late Red, Governor Wood, Knight's Early Black, Napoleon Bigarrean, and Tradescant's Black Heart.

Of the Duke's and Morello's those mostly cultivated are Early Richmond, May Duke, English Morello, and the common red or Kentish cherry.

Several varieties are grown in great abundance in the Annapolis Valley in Nova Scotia, particularly about the Bear river district. They are said to be uniformly productive and profitable. They are chiefly seedling fruits, the relative qualities of which have not yet been fully determined.

In British Columbia all varieties of the cherry grow most luxuriantly and produce heavy crops.

The Apricot.

The Apricot is cultivated to a very limited extent in Ontario, chiefly along the Niagara peninsula. This fruit could be grown in large

quantities in British Columbia where it succeeds well. Breda, Early Golden, and Moorpark are the varieties which have been chiefly tested.

The Nectarine.

This fruit is only occasionally met with, grown in the Niagara district and on the shores of Lake Huron about Goderich.

The Peach.

The peach is grown to a considerable extent along the borders of Lakes Erie, Huron, and Ontario, but especially in the Niagara peninsula. The crop is almost entirely consumed in the home market. The varieties chiefly grown are the Early and Late Crawford, Early Canada, Honest John, Early Beatrice, Hale's Early, Lemon Cling, and Royal George.

The Grape.

But a few years ago it was held that the climate of Canada was quite unsuited to grape culture ; that the winter season was too cold, and the summer too short, to permit of the healthy growth of the vine and the ripening of the fruit. Now many hundreds of tons are annually grown, and the Canadian market, which was formerly supplied almost entirely from the United States, is now cheaply and abundantly furnished with home-grown fruit. This change has been mainly brought about by the introduction of new and earlier ripening sorts, produced from native wild grapes crossed with foreign varieties. The following are among the most popular and widely cultivated sorts, all of which are grown in the open air and ripened without artificial aid : — Agawam, Barry, Clinton, Concord, Delaware, Massasoit, Merrimac, Wilder, Moore's Early, Worden, Burmet, Brighton, Niagara, Early Victor, Jessica.

The Gooseberry.

English gooseberries are not generally grown with much success in Canada, for the reason that the berries mildew before they reach maturity and drop from the bunches ; but there are several excellent sorts of a smaller size which do exceedingly well and bear large crops of very good fruit. These have been produced by improving the native gooseberries by cross-fertilising with the larger English varieties and by selection. Chief among these are Downing's Seedling, Smith's Improved, Houghton's Seedling, and American Seedling, all of which are very prolific, are grown in large quantities for the home market, and freely used by the people of Canada.

The Black Currant.

This fruit is also grown with universal success. The Black Naples is the variety chiefly cultivated, but the wild black currants of the North-west, *Ribes hudsonianum* and *R. floridum*, are highly esteemed throughout Manitoba and the territories, and *R. hudsonianum* is being cultivated by many with success. It is believed to be a heavier bearer than the Black Naples ; has a stronger flavour when eaten fresh, but when made into jelly or preserve is fully equal in quality to the Black Naples.

The Red and White Currant.

Many varieties of these useful fruits are grown with much success in every part of the Dominion. They succeed not only in the Maritime and Central Provinces and British Columbia, but also remarkably well in Manitoba and the North-west Territories, bearing large crops, which are grown chiefly for family use, and to supply the local markets.

Those most esteemed, Victoria, Fay's Prolific, Versailles, Cherry, Red Dutch, and White Grape.

The Raspberry.

Many sorts of this useful fruit are cultivated for market in Canada, and also for canning. The red varieties, most hardy and productive, owe their parentage to the native red raspberry, *Rubus strigosus*, from which they have been produced by cross-fertilisation and selection. The European sorts, derived from *Rubus Idæus*, are not uniformly hardy; in some localities they do well, but in others they suffer from the climate, the canes being partially winter-killed when low temperatures prevail in the absence of deep snow.

The red varieties chiefly grown are Turner Cuthbert, Philadelphia, Brandy Wine, Clarke, Niagara, and Shaffer's Colossal. Of white varieties, Caroline and Buncklе's Orange.

The black cap raspberries are derived from *Rubus occidentalis*, and the following are among those most esteemed:—Mammoth Cluster, Gregg Tyler, Ohio Hilbon, and Davison's Thomless.

Several varieties of the large cultivated blackberry succeeded well in Ontario, Nova Scotia, and British Columbia. The Kittatinny and the Wilson's Early bear heavy crops in some localities, but the Snyder, although not quite so large, is more generally grown on account of its greater hardiness and uniform productiveness. Many other sorts are being tested in different parts of the Dominion.

The Strawberry

Is perhaps more generally and extensively cultivated than any other of the small fruits. Ripening early in the summer, when no other fruits are in season, they are universally appreciated and in great demand; thousands of bushels find a ready sale in the towns and cities, and large quantities are preserved or canned for use later in the season. There are from 40 to 50 varieties in general cultivation, the most popular of which are the following;—Atlantic, Bidwell, Cumberland, Triumph, Crescent, Cornelia, Charles Downing, Daniel Boone, Early Canada, Glendale, James Vick, Jersey Queen, Manchester, Mrs. Garfield, President Wilder, Sharpless, and Wilson's Albany.

Wild Fruits.

The Blueberry.

Under this general term the fruits of several species of *Vaccinium* are included, which are found growing in all parts of Canada, but most abundantly in rocky and sandy districts. The varieties which yield the larger part of the fruit found in commerce are *Vaccinium Canadense*, *V. Pennsylvanicum*, and *V. corymbosum*. Immense quantities of blueberries are sent to the cities and towns of Canada, being gathered by the settlers in the back townships and by the Indians.

This fruit is nearly oblong in form, varies in size from a quarter to three-eighths of an inch in diameter, and is of a dark blue colour, generally covered with a light bloom. The skin is thin, and the pulp sweet and melting, with very small seeds, and a pleasant acidulous taste. A valuable wild fruit, much eaten in the raw state, also in pies and tarts; they are also canned for winter use.

The Saskatoon Berry.

This is known also under the name of Poire. It is the product of *Amelanchier alnifolia*, and is found growing over the whole of Manitoba and the North-west Territories. The shrub varies in height in different localities as well as in the size of the fruit and shape of the leaves. The berries are usually about half an inch long and one third less in diameter; it is rather insipid to the taste, but is sweet and nutritious. It is used by the settlers both fresh and preserved, and by the Indians dried and fresh.

The Cranberry.

Cranberries are the fruit of *Oxycuccus macrocarpus* and *O. vulgaris;* they grow in great abundance in many parts of the Dominion, especially in the Province of Nova Scotia, where they are an important article of export. *O. macrocarpus* furnishes the larger portion of the crop marketed.

Other Wild Fruits.

In addition to the wild fruits already referred to, wild plums occur in abundance in most of the provinces, and in some districts are brought to market in large quantities. Although only one species is recognised, the fruit varies both in size and colour in a remarkable manner. The colours are red, yellow, and dark bluish-purple, and the quality and character of the flesh varies also. In size they range from half an inch to an inch in diameter, varying in form from round to oval.

Several species of the wild cherries are also abundant, notably *Prunus virginiana*, *P. serotina*, and *P. demissa*. The latter, which is believed to be the species that grows chiefly in the North-west Territories, is the only sort eaten, although the fruit of *P. serotina* is sold in the markets and used for making cordials similar to cherry brandy.

The wild smooth gooseberry, *Ribes oxycanthoides*, although of very small size, is a marketable product in the Province of Quebec, and is said to be equal in flavour to the cultivated sorts. The form found in the Maritime provinces produces larger fruit and appears to be equally productive.

Wild raspberries and strawberries both find their way to the markets in the towns and rural districts in very large quantities, especially the raspberry. They are partly consumed in the fresh state and the remainder canned or preserved.

Query 2.—During what months are the chief fruits obtainable; what quantities of each approximately are available for export; and what are the wholesale prices locally?

The early apples begin to ripen in August, and some of the later winter sorts will keep in a cool cellar in good condition until the follow-

ing June; the greater [part] of the crop, however, is shipped during the month of October.

Pears vary much in time of ripening, and cover the season from August to February. Plums ripen in August and September. Cherries in June and July. The apricots ripen a week or two before the early plums, and the nectarine comes in the middle of the peach season, which extends from the latter part of August to the end of September.

Grapes ripen in September, and some of the varieties, if stored in a cool place, may be kept in good condition until the end of December. Gooseberries ripen in July, and black and red currants during the same month. The raspberries begin to ripen during the last week in June and continue until the middle of July. The early strawberries are marketable about the middle of June, and the later varieties prolong the season until about the middle of July.

The quantities available vary much, depending upon the character of the season. The exports during 1885 much exceeded those of 1884, while the crop of 1886, being larger than the two preceding years, will show a much greater increase. The local wholesale prices of apples vary from one dollar and a half to two dollars per barrel; pears from one to two dollars per bushel; plums from one to two dollars per bushel; cherries from five to ten cents per quart; peaches from two to three dollars per bushel; grapes from four to eight cents per pound; raspberries from six to ten cents per quart; currants and gooseberries from five to eight cents per quart; and strawberries from six to eight cents per quart.

Query 3.—What fruits are at present exported (1) in a fresh or (2) in a preserved state? Please state the destination, the quantity, and the estimated value of each port.

The exports of fresh fruits for the year ending on the 30th June 1886 were as follows:—Apples to Great Britain, 176,505 barrels, value $410,898; to the United States, 41,407 barrels, value $55,302; to other countries; 4,831 barrels, value $10,804. Other fruits were exported of the following value:—To Great Britain, $38; to the United States, $22,064; to other countries, $492.

Query 4.—Are all or any of the fruits mentioned above capable of being produced in much larger quantities than at present? If so, what steps are necessary to start or develop a fruit trade, and what inducements, if any, do local men specially desire to open or extend a trade in fresh or preserved fruits either with the Mother Country or neighbouring States?

All the fruits mentioned are capable of being produced in much larger quantities than at present, indeed there is no practical limit to the capacity of Canada for the production of fruit. A very large number of young orchard trees are being planted annually, which will shortly result in a greatly increased yield. The experience gained during the recent Colonial and Indian Exhibition in London has shown the importance of cold storage in the transportation of fruit, especially of the early ripening sorts, and it is highly desirable that facilities in this direction should be offered to the fruit growers of Canada so as to stimulate the export of autumn fruits.

The Government of Canada are establishing in most of the larger provinces experimental farms, where many experiments in fruit production will be carried on, new and promising fruits introduced from all parts of the world with the view of enlarging the area of fruit culture and increasing production. With suitable information given as to the

most profitable sorts to grow, and the excellent facilities now provided for rapid transport, it is believed that the energy of Canadian fruit growers will furnish all the other stimulus needed to enlarge and extend this important branch of agricultural industry, and, with reasonable facilities, furnish supplies for all the markets which may be open to them.

Query 5.—What fruits are now imported into the Colony either fresh or preserved? Please state kind, quantity, and value, and the market from whence derived.

The imports of such fruits into Canada (as might in large proportion be grown here) for the year ended June 30th, 1886, were as follows:—Apples from the United States, 31,575 barrels, value $63,775; small fruits, viz., blackberries, gooseberries, raspberries, and strawberries, from the United States, 231,378 lbs., value $23,557; cherries and currants, from the United States, 51,085 quarts, value $4,914; cranberries, plums, and quinces, from the United States, 17,170 bushels, value $34,650; from Newfoundland, 15 bushels, value $13; grapes from the United States, 389,868 lbs., value $27,340; peaches from the United States, 592,880 lbs., value $42,571.

Canned fruits from Great Britain, 1,512 lbs., value $149; from the United States, 592,391 lbs., value $34,495.

Query 6.—Please add any special points of interest connected with the fruits of the Colony herein reported upon which are desirable to place on record.

It should be borne in mind that a large proportion of the green or fresh fruits imported into Canada from the United States consist of early ripening sorts, which are obtainable from the southern portions of that Republic several weeks in advance of Canadian fruits, and are in demand chiefly among those classes of the community who can afford to pay for such luxuries out of season.

D. M.

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ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 12.] DECEMBER. [1887.

XXI.—CUBEBS.

(*Piper Cubeba*, L.)

The rapid rise in value which in recent years has occurred in cubebs has drawn considerable attention to this pepper. It may be useful, therefore, to correspondents in the Tropics to have before them a brief summary of information on the subject. To this we are enabled to add drawings of the male and female plant of *Piper Cubeba*, L., taken from a Java plant, and one of Miquel's types, in the Kew Herbarium. This is *Cubeba officinalis*, Miquel, and *Piper caudatum*, Hort. non Vahl. There are good figures of this species given by Berg and Schmidt, *Officinellen Gewächse*, t. 29a, and in Baillon, *Histoire des Plantes*, Vol. III., fig. 508. The plant figured by Bentley and Trimen (except the details which are correct) in Med. Plants, plate 243, as from the Royal Gardens, Kew, has been proved to be *Piper Chaba*, Hunter [Chavica officinarum, *Miquel*], belonging to the long-pepper group.

The cubeb plant, like those which supply the black pepper and the long pepper, is a climbing shrub with smooth round stems, which are somewhat swollen at the joints. The leaves are alternate, on short stout stalks, with a lanceolate blade of about 5–6 inches long,

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terminating in a sharp point. The base of the leaf is often unequal and somewhat folded in drying. The flowers are unisexual, and appear on separate plants (dicœcious). They consist of cylindrical solid spikes coming off opposite the leaves. The male spikes are long and slender, while the female spikes are shorter, thick, and fleshy, and provided with a short peduncle.

The fruit (which appears only on female plants) is small, and very similar in size and appearance to black pepper. It is, however, provided with a stalk-like base, which is a little longer than the globular extremity. Numerous fruits, when approaching ripeness, are ranged horizontally on a common axis, forming a lax raceme (*see* engraving). This pepper appears to be found wild only in Java, Sumatra, and Borneo. In the former islands cubebs are regularly grown, and they form an important (though irregular) article of export. They often come to this country through Singapore. According to Descourlitz, cubebs were at one time cultivated as an introduction by the French in the West Indies. At present they are unknown there.

The produce of other species of Piper are sometimes called cubebs, as, for example, the native cubeb of Mauritius (*cubebe du pay*), which is *Piper borbonense*, Cas. De Candolle. The cubeb pepper of West Tropical Africa is *Piper Clusii*, Cas. De Candolle. This latter, according to Stenhouse, quoted by Flückiger and Hanbury, contains Piperin and not Cubebin. Under the stimulus of high prices, numerous adulterants are being introduced to increase the bulk of true cubebs. Amongst these *Piper crassipes*, Korthals, has been lately described (Pharm. Journal, [3], XV., 653, and XVIII., p. 269). The fruits of *Piper caninum*, A. Dietr., a plant of wide distribution throughout the Malay Archipelago, are also introduced. These are smaller than true cubebs, and have a stalk-like base only half the diameter of the globular extremity.

The cultivation of cubebs appears to be very similar to that of the ordinary black pepper. Trees are requisite for shade and for supporting the vines. At the foot of these the young plants are first started. When fully grown the cubeb vine climbs to the height of 18–20 feet, and forms a large bush. In Java small plantations are specially devoted to cubebs; but latterly they have been cultivated also on coffee estates by European planters.

The fruits are gathered when full grown, but before they are quite ripe. They are then carefully dried with the stalk attached; hence on this account they are sometimes called "tailed pepper." Cubebs have a warm aromatic and somewhat "camphoraceous" taste. The smell is highly aromatic, and by no means disagreeable.

Cubebs have stimulant and diuretic properties. The chief use of cubebs in European countries has been for various forms of syphilitic disease. Latterly they have been largely used in America in the preparation of asthma cigarettes.

According to the *Chemist and Druggist* the price of cubebs has always been subject to sudden and violent fluctuations. In 1865 the price averaged 77*s.* 6*d.* per cwt.; from 1875 to 1880 cubebs could be bought at prices ranging from 25*s.* to 55*s.* per cwt. Since 1880 the price has steadily gone up, and "good genuine cubebs" in 1886 realised 20*l.* to 22*l.* per cwt.

In the Kew museums there are specimens of the fruits of *Piper Cubeba* from Nepaul and Madras, India Museum; these are probably bought in bazaars, and not grown locally. Commercial cubebs from Java and Sumatra are represented by samples contributed by Messrs. Burgoyne, Burbidges, and Co. West African cubebs, the produce of



Piper Cubeba, L.—1. Female plant ; 2. Male plant.

Piper Clusii, are represented by specimens from the Yoruba country by Mr. Barber; from Sierra Leone by Dr. Clark; from Bahia, brought from the West Coast of Africa by negroes, under the name of "Irrei," by Mr. J. Wetherell; and from the Sierra Leone exhibits at the Colonial and Indian Exhibition, 1886, under the name of "Yaray," by the Commissioner.

In addition to these there are samples of cubeb oil and cubebine, illustrating the products of *Piper Cubeba;* and samples of false cubebs as usually used for purposes of adulteration, which are probably the fruits of *Piper crassipes*.

XXII.—SABICÙ WOOD.

(*Lysiloma Sabicu*, Benth.)

In the Bahamas Court at the late Colonial and Indian Exhibition there were shown specimens in the form of ship's knees of a timber known locally as "Horse-flesh Mahogany." It was described as a "heavy and rather hard wood, much valued for the framing of houses, high class joinery, and ship-builders' purposes." It was said to be "impervious to all insects and of very great durability, having been found perfectly sound after a century of exposure."

One of the specimens was presented to the museums of the Royal Gardens, Kew, but its botanical origin was then unknown. The value of the timber being unquestionably of a high order, it was thought desirable to ascertain more about it, and, if possible, to determine exactly the species yielding it. With this view, a communication, dated 27 November 1886, was addressed to the Colonial Office, and at the instance of H.E., H. A. Blake, C.M.G., Governor of the Bahamas, Mr. Fred. Taylor was instructed to prepare specimens of the foliage, flowers and fruit of "Horse-flesh Mahogany" and forward them to Kew. The specimens were recently received here, and Professor Oliver arrived at the conclusion that they were identical with *Lysiloma Sabicu*, Benth., a species which has long been known to yield the celebrated Sabicú wood of Cuba. Hence, the point would appear to be established that the Horse-flesh Mahogany of the Bahamas and the Sabicú wood of Cuba are botanically one and the same thing.

Sabicú wood, also known as Savacú and Savicó wood, has been imported in considerable quantities from Cuba, where alone the tree was supposed to exist. It is described as a "dark coloured wood, very "heavy, excessively hard, and extremely durable, the two latter qualities "rendering it of great value to the shipbuilder, by whom it is much "esteemed." The stairs of the building for the great exhibition of 1851 were made from this wood, and, notwithstanding the immense number of people who passed up and down, the wood was found, at the close of the exhibition, to be scarcely at all the worse for wear (Treasury of Botany, p. 704). Sabicú wood has also more recently been used for shuttles and bobbins, but the demand for this purpose was never very large.

Since the botanical identity of Horse-flesh Mahogany and Sabicú wood has been established, it has been found that timber, under the name of "Sabicú," had already been exported in small quantities from the Bahamas, and in the "Report of Governor Robinson on the Blue



M.S.del.et lith.

F.Dangerfield,lith.,London 2.88 15673.

Lysiloma Sabicu, Benth.

Book of the Bahamas for 1879," p. 10, it is stated that 66 tons were shipped in 1879 and 167 tons in 1878. Further, in a letter dated 5th May 1887, Messrs. G. S. Saunders and Co., New London Street, E.C., inform us that they had received "a log of Sabicú from Jamaica, but under a nondescript name"; while several imports of genuine wood had been received from the Bahamas, but generally small and badly grown, and (which Cuba and St. Domingo wood is not) very liable to "wormy centres and outsides."

It is evident that at the Bahamas the tree is much smaller than in Cuba, and, probably owing to the soil or climate, it seldom attains a greater height that 30 feet. The stem also would appear to be stunted and crooked, owing to exposure to strong winds. The trees in Cuba are said to yield fine straight stems several feet in diameter.

Specimens of Sabicú wood in the Kew museums are (1) from the Admiralty, received Nov. 16, 1855; (2) from Messrs. Saunders, received May 1887, said to be slightly "redder in colour" than usual; and (3) to these has now been added the fine piece or "ship's knee" received as Horse-flesh Mahogany from the Bahamas Court at the Colonial and Indian Exhibition, 1886. As regards the latter specimen, the curator of the museums points out that the Bahamas wood is comparatively light in weight, of a reddish colour, with occasional dark streaks. The rings are clearly defined, while the medullary rays are wide and numerous. The pores are small, scattered, and each contains a white deposit. This wood is much softer than the regular Sabicú wood of commerce, and is easily cut.

We are enabled, by permission of the Bentham Trustees, to add to this note a plate prepared for the *Icones Plantarum* of the plant yielding Sabicú wood. This will, no doubt, prove of considerable interest to correspondents in the West Indies; and it may also lead to the tree being recognised as growing in other places than those here indicated.

XXIII.—MEXICAN FIBRE OR ISTLE.

(*Agave heteracantha*, Zucc.)

Under the name of Mexican fibre or istle, a short and somewhat harsh and stiff fibre comes into the London market, which is used in the manufacture of cheap nail and scrubbing brushes, and for various purposes where a substitute for animal bristles is allowed. Messrs. Ide and Christie mention "that this fibre is pretty largely imported for "brush-making purposes, and its value in London [15th October 1887] "is 26*l.* per ton. The range of value of late years has been from 22*l.* "per ton to 50*l.* per ton. The fibre is quite unique as a vegetable "substitute for animal bristles, and is used in the manufacture of cheap "brushes of all sorts."

The origin of this Mexican fibre or istle has been involved in a good deal of doubt, but we believe that we have been able to trace its origin by means of material collected many years ago, and now available at this establishment. Some specimens of a stiff fibre and brushes in the Kew museums were received from Dr. Parry in 1879, and said to be derived from *Agave Lechuguilla*. Dr. Parry wrote the introduction

to Torrey's *Botany of the Mexican Boundary*, which was published in 1858, and he states on page 11, speaking of the vegetation of the cretaceous formation, "Upon the rocky ledges a small species of Agave "grows in abundance. The low leaves, which are pointed with sharp "spines, are very troublesome to the foot traveller; they are, however, "of some use to the Mexicans, who employ the strong fibres they "contain in making coarse ropes. The plant is known to the people "of the country as 'Lechaguia.'"

According to Torrey, in *Botany of Mexican Boundary Survey*, p. 213, it appears there is a distinct species of Agave of this name [*Agave Lechuguilla*, Torrey], and "the fibres of the leaves are used for making coarse rope, bagging, &c." This species, by Baker, in *Gardeners' Chronicle*, Vol. VII. (new series), p. 527, is placed under *Agave Poselgerii*, Salmdyck. Engelmann on the other hand looked upon *A. Poselgerii* and *A. Lechuguilla* as identical with *Agave heteracantha*, Zucc., and described them under that name. Hence we may look upon *Agave Lechuguilla*, Torrey, *A. Poselgerii*, Salmdyck, and *A. heteracantha*, Zucc., as synonymous names representing one and the same plant; and of these *Agave heteracantha*, Zucc., has priority as regards date, being published nearly fifty years ago.*

It would appear, therefore, that Parry's specimens of fibre and samples of brushes made from it were derived from *Agave heteracantha*, Zucc., the local name of which is Lechuguilla. This name is, however, by no means restricted to this species. Sereno Watson (*Proceedings of the American Academy*, Vol. XI., p. 16) mentions "Lechuguilla" or "Lechigilla" as the native name of *Agave guttata* and *A. variegata*. These latter are species belonging to quite another group, and as different as possible from *A. heteracantha*. It is very possible, therefore, that the name Lechuguilla, like Kerrato in the West Indies, has a wide stretch of usage in certain parts of Mexico and the United States, and that it is applied indiscriminately to various species of Agave.

There is at Kew a very large collection of living Agaves, in which are represented most of the species here concerned.

By the courtesy of Messrs. Death and Ellwood, Engineers, Leicester, we have been enabled to extract fibre from the leaves of *Agave heteracantha*, Zucc.; *A. xylacantha*, Salmdyck; *A. horrida*, Lemaire; *A. Kerchovei*, Lemaire; *A. lophantha*, Schiede; *A. univittata*, Haworth; and *A. multilineata*, Baker. All these yield a coarse and somewhat rigid fibre, but the fibre of *A. heteracantha*, allowing for the age of the plant, comes nearest to the commercial fibre known in London as Mexican fibre or istle.

All these species, it may be mentioned, belong to a distinct set of Agaves, the leaves of which are characterized by a continuous horny margin, and hence placed together by Baker under the group Marginatae, of which the distictive characters are,—"edge of the leaf "furnished all the way down from the top to the bottom with a "distinct horny border, of the same texture as the teeth."

The species of *Agave* which yield Sisal hemp and fibres suitable for rope making and weaving, are discussed in the *Bulletin* for March [No. 3, 1887]. Such fibres are ordinarily 3 feet, and often 5 and

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* It may be mentioned here that what Baker described as *Agave heteracantha*, Zucc. (?), in *Gardeners' Chronicle*, Vol. VII. (new series), p. 369, has been proved to be a new species, and it is proposed by him to describe it under the name of *Agave multilineata*,

6 feet in length. They are soft and pliable, not so stout as the Mexican fibre or istle, and would scarcely answer the same purpose. This latter is generally only about a foot or a foot and a half in length, and is stout and rigid.

There is little doubt, therefore, that Mexican fibre or istle is derived from a group of Agaves with short leaves, and from the material available at Kew, the evidence is strongly in favour of *Agave heteracantha*, Zucc., being the species chiefly concerned. Indeed the specimens contributed by Dr. Parry to Kew in 1879, afford direct proof on this point. Since the above remarks were written we have been favoured by Dr. Newberry with a reprint of an article of his in *The Popular Science Monthly* for November 1887, entitled "Food and Fibre Plants of the "North American Indians." At page 10 we find he identifies the "lechuguilla" of the Indians with *Agave heteracantha*, and attention is particularly drawn to the size of the leaves, about a foot to 18 inches in length, and to the very strong character of the fibre contained in them. Dr. Newberry's observations are:—

"Another less known but scarcely less valuable plant belonging to
" the same genius (*Agave*), is the 'lechuguilla' (*Agave heteracantha*)
" of Chihuahua and the surrounding country. Of this, the leaves are
" from a foot to 18 inches in length, and grow in a tuft like those of
" the century plant (*Agave americana*). Though separated with some
" difficulty from the parenchyma in which they are enveloped, the
" fibres that traverse the leaves are numerous and very strong, and
" are largely used by the Mexicans for the manufacture of ropes,
" sacking, &c."

In the Kew museums there are specimens of Mexican fibre as follows:—Prepared Mexican or istle fibre, from Mr. A. Rowbottom; fibre used by the Indians for making ropes and coarse sacking, from Dr. Parry, 1879; a piece of cordage and Mexican hair brush, made from Mexican fibre, contributed also by Dr. Parry; and Mexican fibre or istle as sold in London (value 26*l.* per ton), received from Messrs. Ide and Christie, 15th October 1887.

XXIV.—FOOD GRAINS OF INDIA.*

In an illustrated work entitled the "Food Grains of India," published in 1886, for the Committee of Council on Education, and based upon information acquired by the India Office in connexion with the late India Museum, Professor Church deals somewhat fully with the alimentary value of the chief food-grains of our Eastern Empire.

A few notes on the cultivation of some of the crops have been incorporated with the work, while an endeavour has been made to show how a knowledge of the composition of the several food grains may be utilised in the fixing of rations and the adjustment of dietaries.

Under cereals the classification and characteristics of millets, maize, rice, wheat, and bamboo rice are discussed.

Since the publication of the work in question, Professor Church has extended his investigations with material supplied from Kew into the

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* Food Grains of India, by A. H. Church, M.A. Oxon, F.C.S., F.I.C., with numerous woodcuts.—London: Chapman and Hall, Limited, 1886.

merits of two other grains, viz., the Mitenga bamboo, *Bambusa Tulda*, Roxb., and *Panicum flavidum*, Retz. The results, given below, are intended to be a continuation of, and supplemental to, the information already given in the handbook :—

BAMBUSA TULDA, Roxb. *Synonym : Dendrocalamus Tulda*, Nees. *Hind*, Peka. *Beng*, Tulda, jowa, mitenga, matela. *Burm*, Theiwa, thoukwa, or thaikwa.

This is the common bamboo of Bengal and grows abundantly everywhere. It is also found in Pegu and Martaban, down to Tenasserim, but cultivated in Chittagong and elsewhere (Kurz). The tender shoots are eaten as pickles by the natives. The plants flower in May. The grain examined was received at Kew through the Government of India from the Conservator of Forests, Bengal.

A sample of the grain of this bamboo gave, when freed from husk, the following numbers on analysis :—

Water - - -	13·5 per cent.
Albuminoids - -	10·8 „
Starch - - -	71·6 „
Oil - - - -	·6 „
Fibre - - -	2·1 „
Ash - - - -	1·4 „
	100·0

These per-centages are very similar to those furnished by the grain of *Bambusa arundinacea* (Willd.), but the individual corns are much larger, 70 of them weighing 100 grains, while 300 grains of the latter species are required to make up the same weight.

PANICUM FLAVIDUM, Retz. *Synonym : Panicum brizoides*, L. *Tel.*, Oda, or Woodoo-gaddi.

This grass is widely distributed in the East Indies. Roxburgh describes it as common in every soil and situation, even in deep water ; in one that is rich and moist it is often 2 to 4 feet long, and again on a soil that is dry and barren, only as many inches. It grows in tufts, and various parts of it are often tinged purple. The grain here described was obtained through the Government of India from the superintendent of the Government Botanical Gardens, Saharunpore.

This species of Indian millet is occasionally employed as food, especially in times of famine. The husked grain gave on analysis the following results :—

Water - - -	11·8 per cent.
Albuminoids - - -	9·6 „
Starch - - -	54·1 „
Oil - - - -	6·3 „
Fibre - - -	12·0 „
Ash - - - -	6·2 „
	100·0

The small grains of this millet contain much more indigestible fibre than any species yet examined, but they are exceptionally rich in oil or fat, containing nearly twice as much of this constituent as any other kind.

XXV.—BROOM ROOT OR MEXICAN WHISK.

(*Epicampes macroura*, Benth.)

In the Report of Her Majesty's Consul at Vera Cruz for the year 1886, Mr. Baker draws attention to a comparatively new industry connected with the preparation and export of what is called "Broom Root."

This root was exported from the port of Vera Cruz last year to the aggregate value of 58,632*l*. The bulk appears to have been shipped to Germany and France, while the quantity shipped to England was comparatively small. The Curator of the Museum [Gardeners' Chronicle, Vol. II. (third series), p. 104] has established the fact that the broom root exported from Vera Cruzs is known in Europe as Mexican or French Whisk. It is used by the Germans and French to mix with Venetian whisk, derived from the roots of *Chrysopogon Gryllus*, for the manufacture of dandy brushes, clothes brushes, carpet brushes, and velvet brushes, which are shipped to this country at exceedingly low prices. The broom root, therefore, appears to be a cheap substitute for Venetian whisk, and it is said that when made into brushes and thoroughly dry it is apt to become brittle and break off. For this reason it has never found much favour in England.

As the botanical origin of broom root was unknown, efforts were made through the Foreign Office to obtain specimens of the plants yielding it. These specimens were obligingly forwarded to Kew by Mr. Consul Baker, and received on the 3rd October. It appears that the plant yielding the so-called broom root is a grass whose local name is Zacaton. This is a plant with coarse tufted leaves, found widely distributed over the highlands of Mexico, and attaining a height of six or seven feet. The roots, in the condition in which they are exported, are called "Raiz de Zacaton." These roots are about nine inches to a foot long, possessing a wavy character, and about one-sixteenth of an inch in diameter. They have evidently undergone some cleansing and bleaching process which gives them a bright appearance and a pale yellow colour.

Among the specimens sent by Mr. Baker to Kew there were two species of grasses, both of which evidently belonged to the genus *Epicampes*. One was *Epicampes macroura*, Benth., [Cinna macroura, *Kunth*.], and the other a closely allied species which could not be determined without flowers. There can be little doubt, therefore, that the broom root is derived from one or more species of grasses belonging to the genus *Epicampes*.

Sereno Watson, *Botany of California*, Vol. II., p. 277, mentions the distribution of one species of this genus, viz., *Epicampes rigens*, Benth. (*Cinna macroura*, Thurb.), as San Diego County, California, and also in Mexico and eastward in New Mexico and Western Texas. It is known as "Wood Reed-grass." It is described as a tall-growing, very rigid, wiry grass, of a pale yellowish green colour, growing in sub-alkaline localities and apparently in tufts. The rigid stems are used by the Indians for making baskets.

XXVI.—CONTRAYERVA.

Dorstenia brasiliensis, L.
Dorstenia Contrajerva, L.
Aristolochia odoratissima, L.

Contrayerva, as usually known, consists of the root-stock and roots (scaly rhizomata) of *Dorstenia brasiliensis*, L., and *Dorstenia Contrajerva*, L. The former is a native of the forests of Tropical America from Venezuela to Brazil, while the latter is chiefly confined to the West India Islands and Venezuela. According to Pereira (Mat. Med., Vol. II., p. 1252), *D. brasiliensis* yields "the contrayerva root usually "met with in the shops." It is described as composed of irregularly curved roots of a yellowish brown colour. The taste is warm, bitterish, and slightly acrid.

The name *contrayerva* is an Indo-Spanish term, originally applied to species of *Dorstenia*, on account of the counter-poison properties supposed to be possessed by them. They are, however, little used now, and for all practical purposes are obsolete. They had been employed in fevers of a low type, and in other diseases requiring a mild, stimulant, and diaphoretic treatment. A full description with plate is given of *Dorstenia Contrajerva*, L., by Descourtilz in *Flore Medicale des Antilles*, Vol. III., p. 256, t. 207. The only figure we have met with of *Dorstenia brasiliensis*, L., is given by Nees von Esenbeck in *Plantes Medicinales*, Dusseldorf, t. 99.

Contrayerva, as usually in use, therefore refers to the roots of species of Dorstenia. In Jamaica, however, this term is invariably applied to a species of *Aristolochia*, while roots of *Dorstenia* are there called Spanish Contrayerva. From dried specimens and living plants lately contributed to Kew by the Botanical Department, Jamaica, and by Joseph Shearer, Esq., of Vale Royal, there is no doubt that Jamaica Contrayerva is *Aristolochia odoratissima*, L., a weak climbing plant, very common on roadside walls and banks. The flowers are variegated purple, with a lip 6 inches long and a tail nearly a foot long. The whole plant when dry has a pungent, disagreeable odour. It is figured by Sloane, t. 104, f. 1, and by Descourtilz (as above), Vol. V., t. 536. In Jamaica, where horse-rearing is an important industry, this Contrayerva (Aristolochia) is regularly used in treatment as a powerful anthelmintic. It is evident that it has been so used for a long period. In Lunan's *Hortus Jamaicensis*, Vol. I., p. 232, we find that—

"This [plant] is called Contrayerva in Jamaica, from its great efficacy "against poisons, but is in no respect like the Spanish contrayerva."

. . . . . .

"The roots and seeds are very bitter, hot, and odoriferous, and are "most excellent alexipharmics or counter-poisons, strengthening the "heart, stomach, and brain; they cure the bites of serpents, and the "poison of Indian arrows. I am of opinion, it exceeds the Spanish "contrayerva, especially in dropsies."

Long, in the history of Jamaica, p. 717, mentions that this Aristolochia "abounds everywhere among the woodlands and thickets "on the south and north sides of the island, and rises frequently to a "considerable height among the trees and bushes. It destroys worms, "for which purpose the root (which has a strong smell) is chopped in "small pieces, and given by the planters to their horses, mixed with

" corn, which destroys bots, and wonderfully recruits the animals' flesh
" and strength.

" It is so abundant in this island that it may be collected annually,
" in large quantities, for exportation, if there was a demand for it at
" the home market ; and it seems to merit this encouragement, as it has
" been thought by very able physicians to be superior in efficacy to
" the Spanish contrayerva."

XXVII.—INTRODUCTION OF THE BRAZIL NUT TO THE EAST INDIES AND AUSTRALIA.

(*Bertholletia excelsa*, Humb.)

The plant yielding the common Brazil nuts of commerce is a lofty tree, locally known as "Castanea," native of the forests of Guiana, Venezuela, and Brazil. It grows gregariously in large forests, and belongs to the tribe *Lecythideæ* of the natural order *Myrtaceæ*. The "nuts," generally from 15 to 25 in number, are contained in a spherical shell about the size of a child's head, but of an extremely hard woody texture. Inside this the nuts are closely packed round a central axis, and hence the wedge-shaped or triangular form assumed when ripe. The walls of the shell are about half an inch in thickness, and they are so firm and compact in texture that it necessary to break them with an axe before the triangular wrinkled nuts can be extracted. This latter work is done by Indians, in the forests, and the nuts are then brought down the rivers in canoes to the port of shipment.

Brazil nuts form an important article of commerce, and about 70,000 bushels are annually imported into this country and used chiefly for dessert purposes. The ordinary kinds come from Pará and are sometimes called Pará nuts. The best nuts, styled "bold Manáos Brazils," which command the highest prices, come from Manáos, an inland town on the Rio Negro, and in the province of that name.

The nuts ripen and fall from the trees in February and March, and fresh nuts arrive in Europe in May and June.

While the nuts are largely exported they are also extensively used in Brazil, but chiefly as food by the Indians; the Tapejos, for example, subsist largely upon them. The oil contained in the kernels is used locally, and to a small extent in commerce.

The Brazil-nut tree is a native only of South America, and it is scarcely known under cultivation outside the tropics of the New World. It was introduced to Jamaica as lately as May 1881, when 300 fruits, containing about 6,000 seeds, were obtained by the Botanical Department of that colony direct from Pará. Seeds were first of all distributed amongst cultivators and afterwards growing plants. The germination of the seeds, covered as they are with a dense woody testa, is a subject which requires some attention. If the seeds are sown in the natural state and without any preliminary preparation the period of germination may extend from a few months to nearly two years. In the report of the Director of Public Gardens and Plantations, Jamaica, for the year 1883, it is stated, " Before being planted, it is advisable to
" take the nuts out of the pericarps or fruit cases and soak them in
" water for about a fortnight, otherwise they take several months or

" even a year or two in germinating. Some nuts planted in May 1881, " without soaking, only appeared above ground in February 1883."

At Kew the results have been very much the same. The assistant curator, in a memorandum on the subject, states that "if the seeds of " Brazil-nuts are sown with shells intact, they remain in the soil a long " time without germinating. They do not, however, perish, and we have " succeeded in getting plants from seeds that have been sown over two " years.

"By removing the shells from the seeds before sowing they will " germinate in a very short time. At Kew, we had the young plants " through the soil ten days after date of sowing. The shells, in this " case, had been cracked and carefully removed from the seeds."

The introduction of the Brazil-nut tree into our Eastern and Australian Colonies was in every way so desirable an object that this establishment, which has in many ways and for a long period, served as a " half-way house " between the two tropics, was very happy to take part in it. An application having been received from the Botanic Garden at Brisbane, Queensland, for seeds or plants of *Bertholletia excelsa*, about ½ cwt. of fresh seed was obtained in June 1885, and forwarded to the Colony. The first report received on this consignment was not encouraging. The superintendent, in a letter dated 22 February 1886, states :—" I very much regret to say that the *Ber-* " *tholletia* seed, respecting which you took so much trouble, has not " been a success. Besides sowing large quantities myself without " delay, I distributed it over a wide range of Northern Queensland, " but none of the seeds germinated." It was believed here at the time that some of the seeds would still germinate if they were kept in a suitable situation ; but in order to ensure the introduction of the tree to Queensland, a second lot of seeds were forwarded in July of the present year. At the same time a lot was forwarded to the Botanic Gardens at Singapore. In acknowledging the receipt of the second lot of seeds, Mr. Cowan in charge of the Botanic Gardens at Brisbane, writes as follows :—" The previous consignment was submitted to such " treatment as you advised, with the result that there are now available " for distribution about 200 plants of this valuable tree. This second " importation will enable a thorough trial to be made in all likely parts " of the Colony."

Mr. Cantley, in reporting the arrival of the seeds at Singapore, mentions that those which were packed at Kew in moist peat had begun to germinate on the voyage. The other sent dry, had not germinated, but were placed under treatment at once. Mr. Cantley adds, " I have sent a " few of the seeds to the native states, where they are very anxious to " get anything of this kind."

The further introduction of the Brazil nut to Eastern Colonies is a matter which does not appear to require arrangements of an exceptional character. Fresh seed may be obtained in London from reliable merchants in June and July of each year, and these could be sent packed in cocoa-nut fibre or peat in an ordinary box as merchandise. On arrival, the seeds should be well soaked or the outer shell might be very carefully cracked and removed or cracked only, and the kernels sown in ordinary nursery beds. It is necessary to add that the trees do not come into bearing for some years and they evidently require to be planted in deep alluvial soils, and in sheltered situations.

The germination of the seeds of Bertholletia in the wild state, while enclosed in the wonderfully strong fruit case (which, by the way, serves as an admirable protection against monkeys and other animals), was a matter which, for a long time, was involved in obscurity. This, however,

has been cleared up by the observations of Mr. Barrington Brown, F.G.S., in British Guiana. Briefly stated, the process is as follows :—"In "each fruit case, or pericarp, when lying on the ground, there is a small "hole at the point at which it was attached to the stalk. Through this, "after the fruit has been lying for some months in a moist situation, "the shoot produced by one of the germinating seeds is able to effect an "exit. When this is done, it gradually increases in size, but still uses "the fruit case which indeed protects its roots and serves all the "purposes of a natural pot. The other seeds, unable to find an outlet "for their sprouts to reach the light and air, ultimately perish, and their "remains probably go to nourish the solitary plant which is destined to "represent the family. This latter, when it has grown to a certain "size, bursts the shell in which its roots have hitherto been confined "and grows up into a tree."

XXVIII.—CASTILLOA RUBBER OF CENTRAL AMERICA.

(*Castilloa elastica*, Cerv.)

This is one of the earliest described of rubber-yielding plants, but according to Sir Joseph Hooker (Trans. Lin. Society, Vol. II., pt. 9, p. 209), it is probable that more than one rubber-bearing species exists in Central America under this name.

The Ule of British Honduras and Nicaragua is no doubt *Castilloa elastica* of Cervantes, but what is known locally as Tunu and said to yield a "gutta-percha," is so far undetermined owing to the absence of good specimens of the leaves and flowers. The species named *Castilloa Markhamiana* (Collins, Report on the Caoutchouc of Commerce, 1872, p. 12, t. 3) has been shown to belong to another genus, viz., *Perebea* (Genera Plantarum, Vol. III., p. 372).

Plants of *Castilloa* have been widely distributed from Kew to various tropical colonies, and seed-bearing trees are now found in Ceylon, Singapore, Mauritius, Jamaica, Trinidad, and the west and east coasts of tropical Africa.

The original stock of Kew plants was obtained by Mr. R. Cross in 1875 for the India Office from the Isthmus of Panama, under the name of Caucho. The identity of the Ule of British Honduras with the Caucho of Darien appears to be not fully established. The points of difference so far noticed are, however, very slight. With regard to Ule, Sir Joseph Hooker mentions that "all the branchlets are clothed "densely with substrigose buff-coloured hairs; the leaves are scabrid "above, and densely hirsute or hirsutely tomentose beneath. On the "other hand, Cross's indigenous specimens of Caucho, and those culti-"vated in Ceylon (derived from the same source), have the branchlets "less clothed with hairs and the under surface of the leaves less thickly "tomentose."

The above brief statement respecting the determination of the rubber-yielding plants of Central America will serve to show the present position of our knowledge of the subject.

The plants distributed from Kew, and now under cultivation in various tropical colonies, would be more correctly termed according to the place of origin *Darien Castilloa*. This would distinguish them from the Ule of Mexico, British Honduras, and Nicaragua, and sufficiently indicate their history. As regards the quality of rubber yielded by the Darien

Castilloa, the Kew Report for 1882, p. 40, gives an account of the first sample of caoutchouc obtained from this plant in the Old World.

"In October 1882, the Director of the Royal Botanic Gardens, " Peradeniya, Dr. Trimen, forwarded to Kew a sample of the rubber of " *Castilloa elastica* grown in the Experimental Gardens at Heneratgodde, " Ceylon. This was sent from Kew in 1876 (*see* Kew Report, 1876, " p. 9). The sample was submitted to S. W. Silver, Esq., F.L.S., who " very kindly reported upon it :—' On working and drying a portion of " ' this sample, the loss is 12·3 per cent; it is necessary to use warm " ' water in washing this rubber; it becomes, on drying, much darker " ' and shorter than Para rubber. It has a bitter taste, which is not " ' removed on washing. The unwashed sample yields 1·9 per cent. " ' ash, the washed sample gives 1·2 per cent. The shortness of this " ' rubber would restrict its use to some extent where tensile strength " ' or tenacity is required.' It was valued, Dec. 8, 1882, as worth " 2*s*. 9*d*. to 3*s*. per pound."

The collection and preparation of rubbers as a forest product has hitherto been almost exclusively in the hands of natives, whose only object has been to obtain as large a quantity as possible of a marketable character, without any regard to the permanency of the industry or the quality of the article produced. In many localities the rubber trees have been so ruthlessly cut down or tapped, that they have been almost annihilated. In others, the preparation of the rubber is of so rude and unsatisfactory a character, that the waste must be enormous. Under these circumstances it is most important to extend knowledge of the subject, and it is to be hoped where rubber trees still exist under British influence, that careful steps will be taken to regulate the tapping or bleeding, and to re-plant areas already denuded of trees.

In the special instance of the rubber industry at British Honduras we have been lately favoured with the following correspondence ;—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

" Colonial Office, Downing Street,
" SIR, 11th November 1887.

" I AM directed by Secretary Sir Henry Holland to transmit to " you a memorandum on the cultivation and preparation of india-rubber, " which has been prepared by Mr. Alvan Millson, who was formerly " a district magistrate in British Honduras, and has now been appointed " to be a district commissioner in the colony of Lagos.

* * *

" I am to request that the memorandum, which is sent in original, " may be returned with your reply.

" I am, &c.,
" D. Morris, Esq. (Signed) JOHN BRAMSTON."

NOTES on CASTILLOA RUBBER TREE of BRITISH HONDURAS, by MR. ALVAN MILLSON.

There is but little to be added to the admirable account given by Mr. Morris (now of Kew) of the *Castilloa elastica* in his book on the colony of British Honduras; but the cultivation and preparation of india-rubber is of daily increasing importance, and there is little doubt that information which in any way lessens the difficulties at present encountered in dealing with this article is worthy of statement and examination.

Cultivation.—The details I am able to give with regard to the cultivation of the rubber tree are mainly founded on hearsay evidence, but

many of them have also come under my own observation. The present methods may be classified under two heads:—

(i.) Cultivation as a shade tree for other crops, and

(ii.) Cultivation for its own sake.

(i.) The rubber tree is a tap-rooted tree, of small foliage area, a lover of deep, moist, clayey loam, well shaded by undergrowth, and appears to need surrounding low bush to force it to its full height.

The natural deductions from the above facts are that while it does not exhaust the soil in which the surface rooting crop underneath it may be planted, it gives but little shade unless planted at very short distances. Until it has attained sufficient dimensions to shade *itself* (for it will not grow well if the sun gets at its trunk) and the plants beneath its branches, it must be protected by some other shade tree, its natural habitat, like that of the Jamaica pimento, being in old plantations among the under-brush that so rapidly springs up in humid soils. If planted sufficiently closely to shade its own stems, without which both the growth and flow of milk will be checked by the heat of the sun, it must of course ultimately damage the crop beneath it, and, in the case of cacao, when both crops come to maturity about the same time, both crops would be injured to an almost equal extent.

(ii.) If grown as a special crop, the seeds should be planted, I believe, at a distance not exceeding 15 feet from one another, should be left for a year or two in uncleaned ground so as to allow the under-bush to shade them and stimulate their growth,—a small area of about a foot in diameter being kept clear round each plant,—and only when sufficiently large to shade one another to a certain extent should the plantation be thoroughly brushed with a machete.

On the plantation of M. Lefebvre (No. 7, Rue des Petits Hôtels, Paris), in the western district of British Honduras, several trees planted and treated as just described reached a diameter of nine inches at a height of four feet from the ground, and flowered and fruited in less than four years. Others in well-cleaned land did not make half this progress.

Stakes, if set in the ground, make more apparent progress than seeds (seedlings should not, I think, be planted, on account of the extreme length and delicacy of their tap roots), but two or three years suffice to show that the seeds make more certain and rapid progress.

I have reason to believe that the *Castilloa elastica* affects the neighbourhood of rivers chiefly, because the bush in such places is always stunted by the floods so as to allow the rubber trees to have full growth, and is yet sufficient to give the ground and stems full shade. Under these circumstances the trees will reach a great size, while in identical soil in the open savannah they make no apparent progress.

Preparation.—A great difficulty has hitherto been found in extracting the milk from the tree in a satisfactory manner. The method now employed is wasteful both of time and of the quantity and quality of the milk extracted. I append a rough sketch of a machine* invented by Mr. Blancaneaux, of the Cayo, British Honduras, which avoids all these disadvantages.

Coagulation.—The methods which at present prevail for coagulating the milk are well described by Mr. Morris. I cannot but think, however, that a plan suggested to M. Lefebvre by a series of experiments in the spring of this year (sample of the result of which I possess, and will forward at a later date,) offers decided advantages over any other.

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* Not reproduced.

M. Lefebvre's method.—The milk is put into a barrel with a tap at the bottom, and three parts of pure limeless water are added to every part of milk. After standing for twenty-four hours the water is drawn off through the tap and the process repeated twice more. The well washed milk is then pressed slowly in a finely perforated vessel and yields a quality of rubber free alike from undue viscosity and brittleness. A sample of rubber thus prepared is difficult to distinguish from the smoke-coagulated Pará rubber which at present leads the market.

The above account, given by Mr. Millson, is printed without any expression of opinion as regards the value of the suggestions made. Experience alone can decide the circumstances best suited to the cultivation of this tree in different tropical colonies. There is also much more to be learnt and worked out as regards the best means to be adopted for tapping rubber trees, and for preparing the milk so as to yield the largest available amount of marketable rubber.

The preparation of Castilloa rubber is described by Morris (Colony of British Honduras, p. 76), as follows :—

"At the close of the day the rubber-gatherer collects all the milk, " washes it by means of water, and leaves it standing till the next " morning. He now procures a quantity of the stem of the moon-plant " (*Calonictyon speciosum*), pounds it into a mass, and throws it " into a bucket of water. After this decoction has been strained, it " is added to the rubber-milk, in the proportion of one pint to a gallon, " or until, after brisk stirring, the whole of the milk is coagulated. " The masses of rubber floating on the surface are now strained from " the liquid, kneaded into cakes, and placed under heavy weights to " get rid of all watery particles. When perfectly drained and dry, the " rubber cakes are fit for the market, and exported generally in casks."

The idea respecting the preparation of rubber, as suggested above by Mr. Millson, without the aid of the moon plant or of alum, which latter is also sometimes used, would appear to be not entirely new. In the Report on the Caoutchouc of Commerce, by Collins, published in 1872, it is stated that if the juice of plants is not procurable " about two parts of water are added to one part of milk, and allowed " to stand for 12 hours. The residue which separates from the water " is poured into vats made in the ground and left to dry. This " drying takes from 12 to 14 days. Sometimes the milk is simply " poured on prepared ground, and the watery portion allowed to evapo- " rate or otherwise disappear. The rubber, when dry, is subjected " to pressure in order to get rid of the *bolsas* or pockets of watery " liquid."

D. M.

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